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This book of ceramic project ideas is for teacher or student use in secondary industrial arts courses. It was developed in a workshop by teachers. The content objectives are to provide useful projects and units of instruction and to give direction to ceramics instruction which is in keeping with a changing technology. Forty-one project plans are presented under these units: (1) Hand Forming, (2) Slab Constructing, (3) Free Forming, (4) Press Molding, (5) Solid Casting, (6) Slip Casting, (7) Extruding, (8) Throwing and Turning, and (9) Jiggering. Each unit gives project plans, student activities, project procedures, related technical information, teacher demonstrations, related cultural information, and references. Similarly organized units cover 13 tools or pieces of equipment such as a jigger arm, stilts, an extrusion press, and a turning box. Information concerning the making of glazes is also included. Supplementary materials include a glossary of ceramic terms, a bibliography of books and periodicals, and indexes to related technical and cultural topics. (EM)

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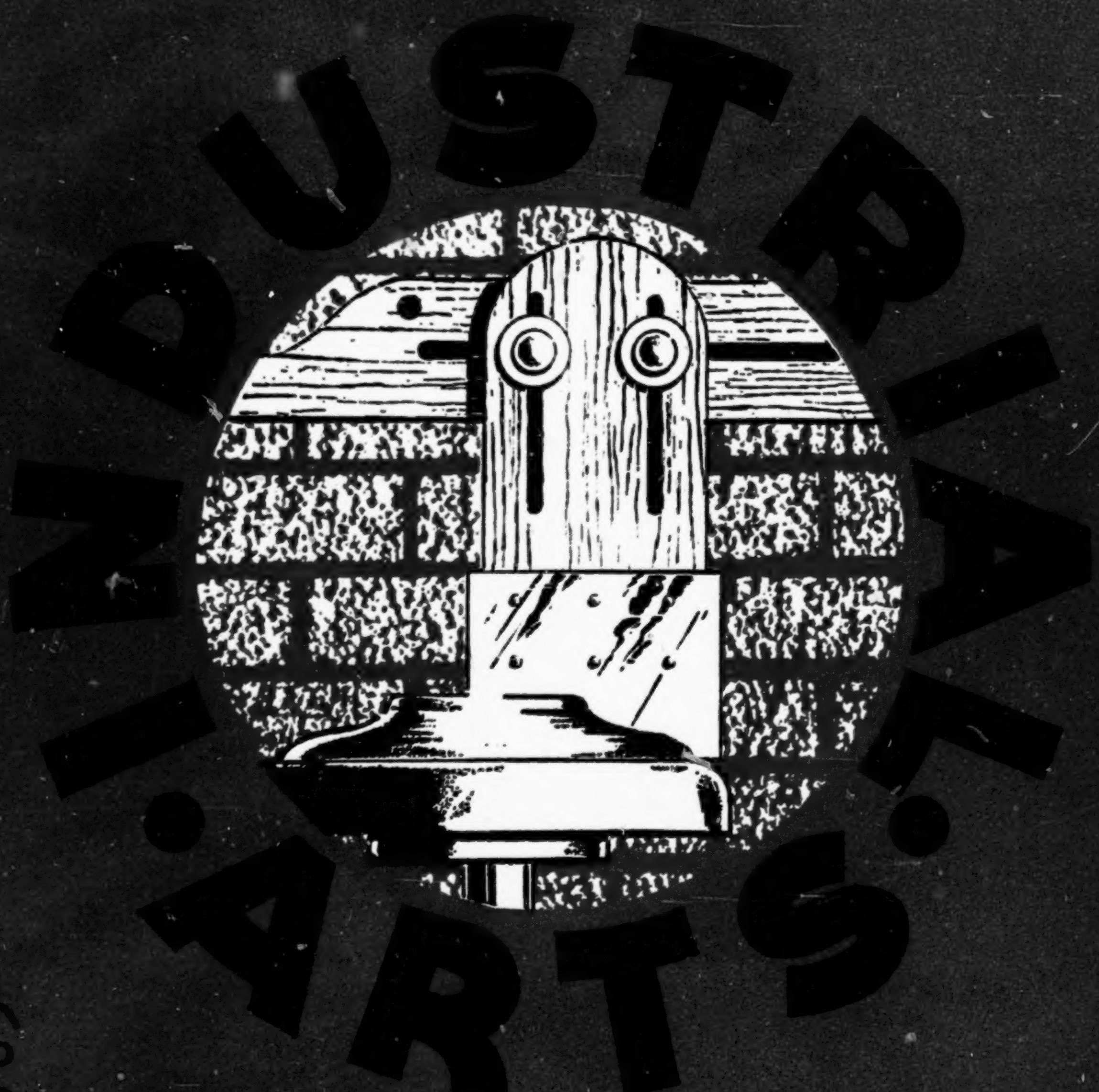
CERAMICS

PROJECT IDEAS


INDUSTRIAL ARTS

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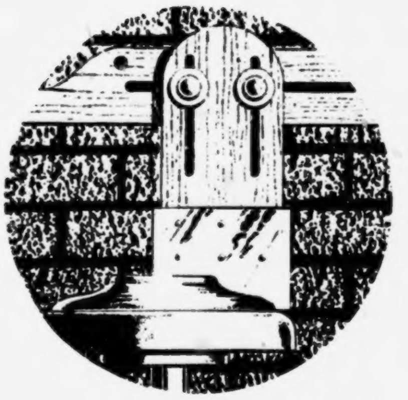
Ceramics, Project Ideas

FOR

INDUSTRIAL ARTS



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TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) Albany, New York 12224

DATE: August 14, 1968

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(3) Utilization of Material:
Appropriate School Setting For junior and senior high school
Type of Program Useful in comprehensive and general shops
Occupational Focus Useful in interesting & informing students about industrial /and craft ceramics
Geographic Adaptability Universal application
Uses of Material Material designed for teacher and student use. Contains well /designed projects & ind. methods.
Users of Material Teachers and students

(4) Requirements for Using Material:
Teacher Competency An IA teacher with at least an introductory course in Ceram
Student Selection Criteria No special student requirements except that the material is chiefly at the secondary level.
Time Allotment This is an idea or supplementary source. No particular time element is involved.
Supplemental Media --
Necessary ____)
Desirable ✓) (Check Which)

Describe The usual equipment of a ceramic shop (kiln, hand tools, jigger equip potters wheel) is needed. Plans for jiggering, extruding, banding etc. equip are included.
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PREFACE

This monograph was produced by the State Education Department, working in conjunction with public school teachers and personnel at State University College, Oswego. The manuscript was prepared in a project development workshop at the college.

The content supplements the industrial arts education syllabus in general ceramics. It furnishes suggestions which emphasize the importance of ceramics materials and processes in the production of many useful articles.

Emphasis on ceramics processes will be found primarily in those units dealing with jiggering, extrusion, press molding, decorating with stencils, drain molds, and mold making. Another aspect of modern research and development is implied and encouraged in a section of each unit titled: Research Activities.

The projects and units of instruction in this project idea book may be used in the comprehensive general phase of the program in grades 7 and 8; others will be most useful when included in the high school phase of general ceramics within the context of a total industrial arts program.

The purpose of this publication is to give a direction to ceramics instruction that will be in keeping with changing technology. It is designed to assist the teacher in extending and enriching a ceramics offering by placing emphasis on industrial processes and their relationship to industrial arts education.

GORDON E. VAN HOOFT
Chief, Bureau of Secondary
Curriculum Development

WILLIAM E. YOUNG
Director, Curriculum
Development Center

ACKNOWLEDGMENTS

This book was developed during the summer session of 1958 at the State University College at Oswego, in a curriculum construction workshop. The work was organized and coordinated by the Bureau of Industrial Arts Education of the State Education Department and supervised by Dr. James R. Hastings, Professor of Industrial Arts Education. Assistance and cooperation in carrying on the workshop was provided by Arthur Hauler, former Chairman, Department of Industrial Arts Education, and Dr. Robert D. Helsby, then acting Director of the Division of Industrial Arts Education, now Executive Deputy Industrial Commissioner of Labor, New York State Department of Labor, who made facilities of the college available for the shop course and curriculum workshop.

The planning and development of this publication was initiated under the leadership of Arthur F. Ahr, Sr., former Chief, Bureau of Industrial Arts Education.

During the first 4 weeks of the summer session, Thomas O. Gangi, teacher of industrial arts ceramics, Halsey Junior High School, Rego Park, Queens, taught a course in advanced ceramics. The class met 5 days a week for 4 hours. Two hours a day of the first 4 weeks were also devoted to the preparation of manuscript material. This work was continued on an 8 hour-a-day basis for the last 2 weeks of the 6-week session. The four teachers appointed to the workshop and Mr. Gangi planned and made drawings of the various projects with the assistance of Arthur F. Ahr, Jr., Milne High School, Albany, who was employed as an artist with the workshop.

Chester Clarke of Schenectady served as draftsman on the project and made most of the mechanical drawings. Photographs of projects and pieces of equipment were taken by James McGuire of Watertown High School. Many of the photographs were processed by Charles Konecky of North High School, Binghamton. Editing of the manuscript material and guidance of the production work was done by Dr. James R. Hastings, Professor of Industrial Arts Education, State University College at Oswego.

The original work was done by Mr. Gangi and four teachers of industrial arts education: Austin Blake, then of Corning Free Academy, now of State University College at Oswego; James Hatch, Gates-Chili Central School; John Hennessey, then at Troy High School; L. Stanley Zielinski, State University College at Buffalo. Wayne Crosby, a graduate student at the time, then teaching at Fairport, made several contributions.

Appreciation for the time and unlimited effort is hereby extended to all who participated with the curriculum group in the advanced ceramics course where the projects were developed.

Acknowledgment is made to Frank E. Howard, former Associate in Vocational Curriculum Development, Bureau of Vocational Curriculum Development and Industrial Teacher Training, for cooperation in planning the curriculum workshop and for technical and other assistance in preparing the manuscript for publication.

Ceramics, Project Ideas for Industrial Arts should become the property of a school shop. As such, it will serve hundreds of pupils.

ARTHUR J. DUDLEY, *Chief*
Bureau of Industrial
Arts Education

JOSEPH R. STROBEL
Assistant Commissioner for
Instructional Services
(Vocational Education)

TO THE TEACHER

This book of project ideas is of value to beginning teachers as a source of content to teach as well as a source of articles for students to make. Experienced teachers should find in it many new ideas and techniques worth adding to those already being taught. One of its purposes is to help bring together craft activities most industrial arts teachers have been using and newer concepts in which more industrial processes and materials are used and research and development techniques are employed.

The material in this book is supplied as an adjunct to an established course of study. It, in itself, is not intended to be one.

Each unit, with the exception of a few toward the end on tools, equipment, and techniques, contains an illustration of a suggested article that can be made and minimum directions for making it. Some units have completely developed working drawings while others leave latitude for student development. Alternate designs are given to indicate adaptability. Originality on the part of students should be expected.

Project planning by students can proceed naturally from the project suggestions presented. A student ordinarily should begin by making several idea sketches of the article he and you have agreed would be educationally valuable for him to undertake. After selecting the one to develop, he should make detailed working drawings, itemized bill of materials needed, and a listing of the general steps to take to get underway or perhaps to complete the job.

How to perform many operations and processes can be found in the references listed at the end of most units. Approximately a dozen units toward the end of the book deal with equipment which will contribute to the development of industrially related processes.

The more important demonstrations which might be presented are listed in each unit.

Most units include a Related Cultural Section to widen the horizon of students that they may become better prepared to understand the vast involvement of industry, past and present, in man's development and present position. All of the evidences of cultural achievements of our forefathers survive to our day through the skill of the workers in metal, wood, parchment, clay, fibers, and other durable goods. Students should come to realize that it is the arts, crafts, tools, knowledge, skills, and industry, as well as literature and beliefs of a people, which make up its culture.

Likewise, a section on Related Technical Information is included to capture the students' interest and to help him solve problems. It should suggest a host of similar topics which they may investigate and which teachers may use to vitalize lesson presentations. Lists of the Related Cultural and the Related Technical Information units are found in the appendixes.

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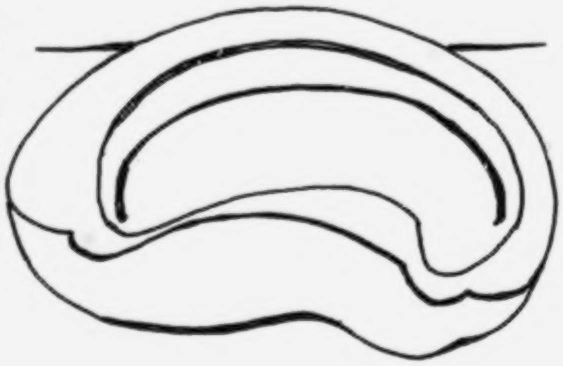
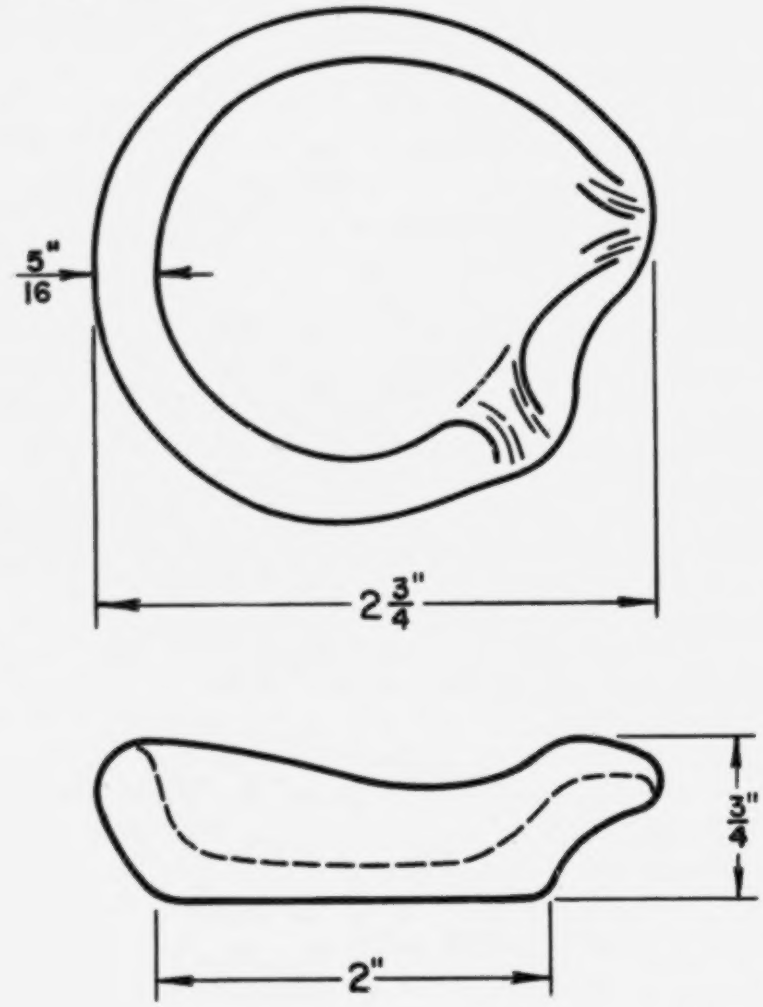
HAND FORMING

PINCH POTS

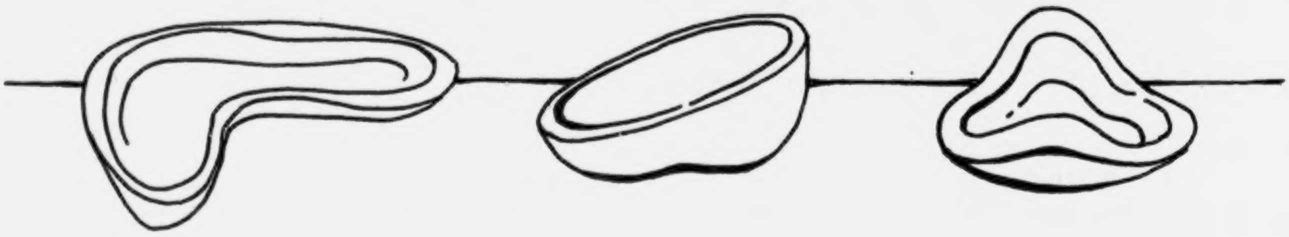


Pinched articles are excellent projects for the beginning student of ceramics. Many useful articles such as ashtrays, candlestick holders, and pin dishes can be produced in free-form designs with pleasing results.

Working Drawing



Alternate Designs



Research Activities

Collect several free-form shapes of rocks found along creeks and lakes. Use this collection of sizes and shapes for suggested basic design of a pinch pot.

Procedure

Prepare clay to a plastic workable state.

Shape ball into a ball about size of a tennis ball.

Flatten ball slightly on one side.

Pinch the top from the center out to open the ball. Leave a sufficient thickness of clay to form as adequate base (figure 1).

Pinch walls to desired shape approximately ½-inch thick (figure 2).

Remove creases, small cracks, and sketch marks by continuously smoothing the clay with moistened finger tips.

Press, curl, or pinch the walls to the desired shape. Walls should be no less than ¼ inch at any point.

Smooth surface with moist sponge.

Before firing, set piece aside to dry completely.

After bisque fire, decorate with mat or majolica glaze and fire.

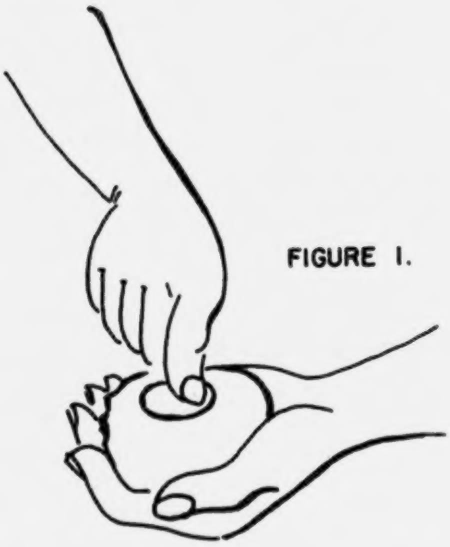


FIGURE 1.

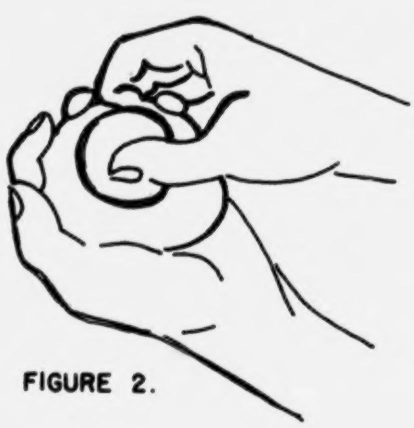


FIGURE 2.

Related Technical Information

Plasticity of Clay:

Plasticity is the property by which we know clay. Without it, clay would be useless for pottery making.

To test for plasticity, roll out a rope about the thickness of a pencil. Bend it into a short loop and see if it has cracked in the bend. A clay which breaks may be too dry. A clay that is too plastic is useless for pinch work. The clay should be soft and smooth, but not sticky, when ready for use.

Another topic to explore:
Properties of Clay: Shrinkage and Vitrification

Demonstrations

Prepare moist clay.
Wedge clay.
Do pinch forming.
Apply glaze.

Related Cultural Information

Meaning of "Ceramics":

Ceramics may be defined in a somewhat broader sense than the dictionary definition of "pottery" implies. It seems evident that the Greek word Keramos meant "burnt stuff"; thus our modern term, ceramics, which includes whitewares, enamels, refractories, glass, cements, fired building materials, and abrasives, is compatible with the original usage.

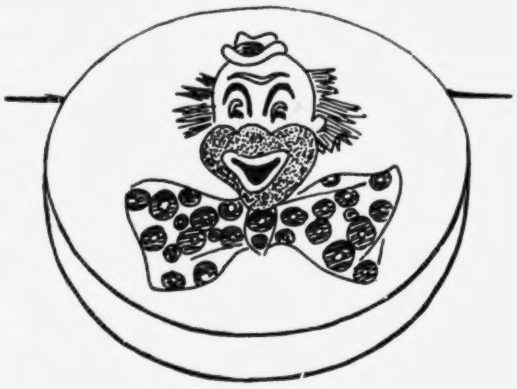
References

Norton, F. H. *Elements of Ceramics.* p. 1
Olson, D. W. *Hand Forming Operations.* p. 16

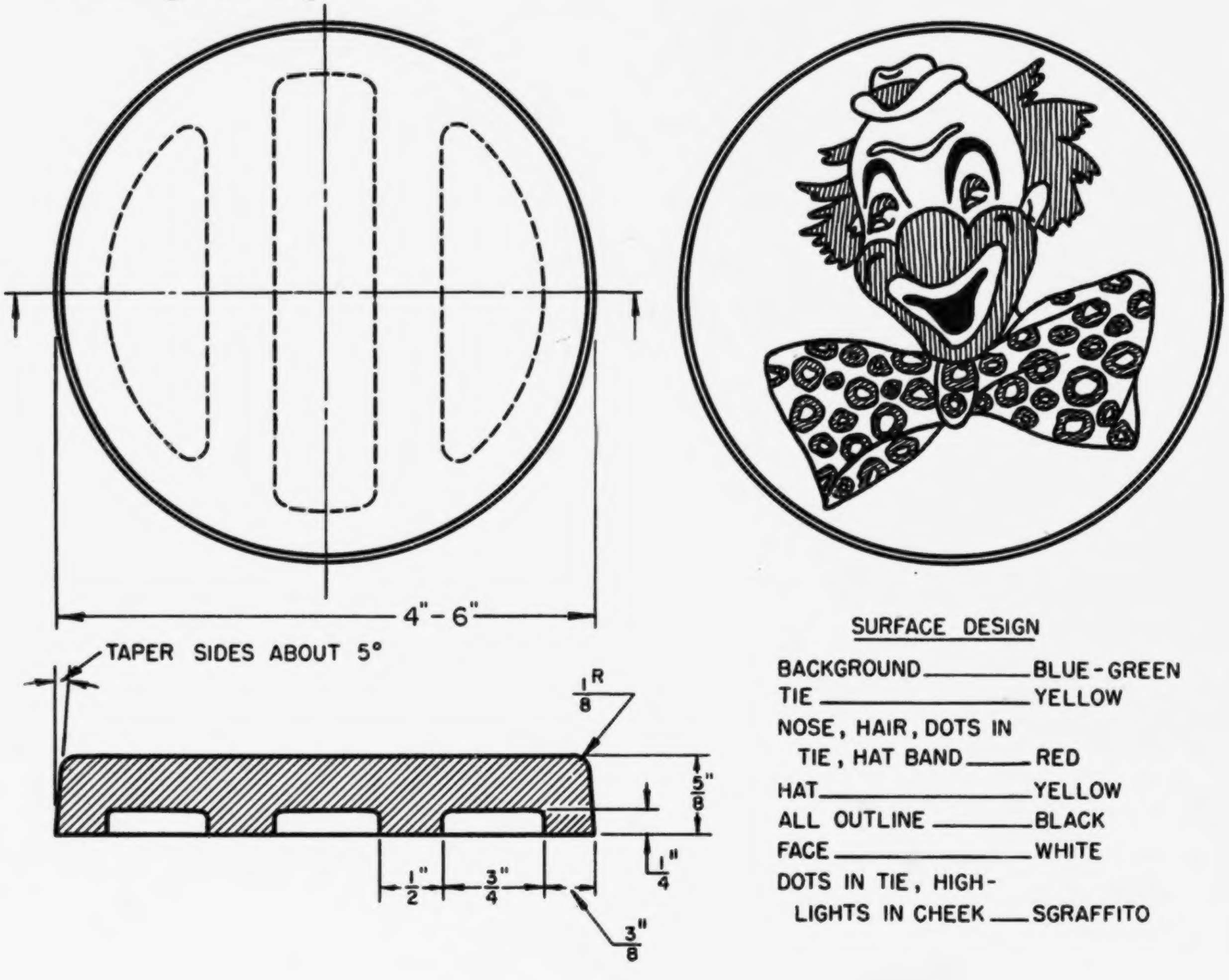
SLAB CONSTRUCTING

HOT PLATE TILE

A tile for protecting the finish of tabletops from hot articles or for purely decorative purposes offers many possibilities for variation of size and decorative effects.



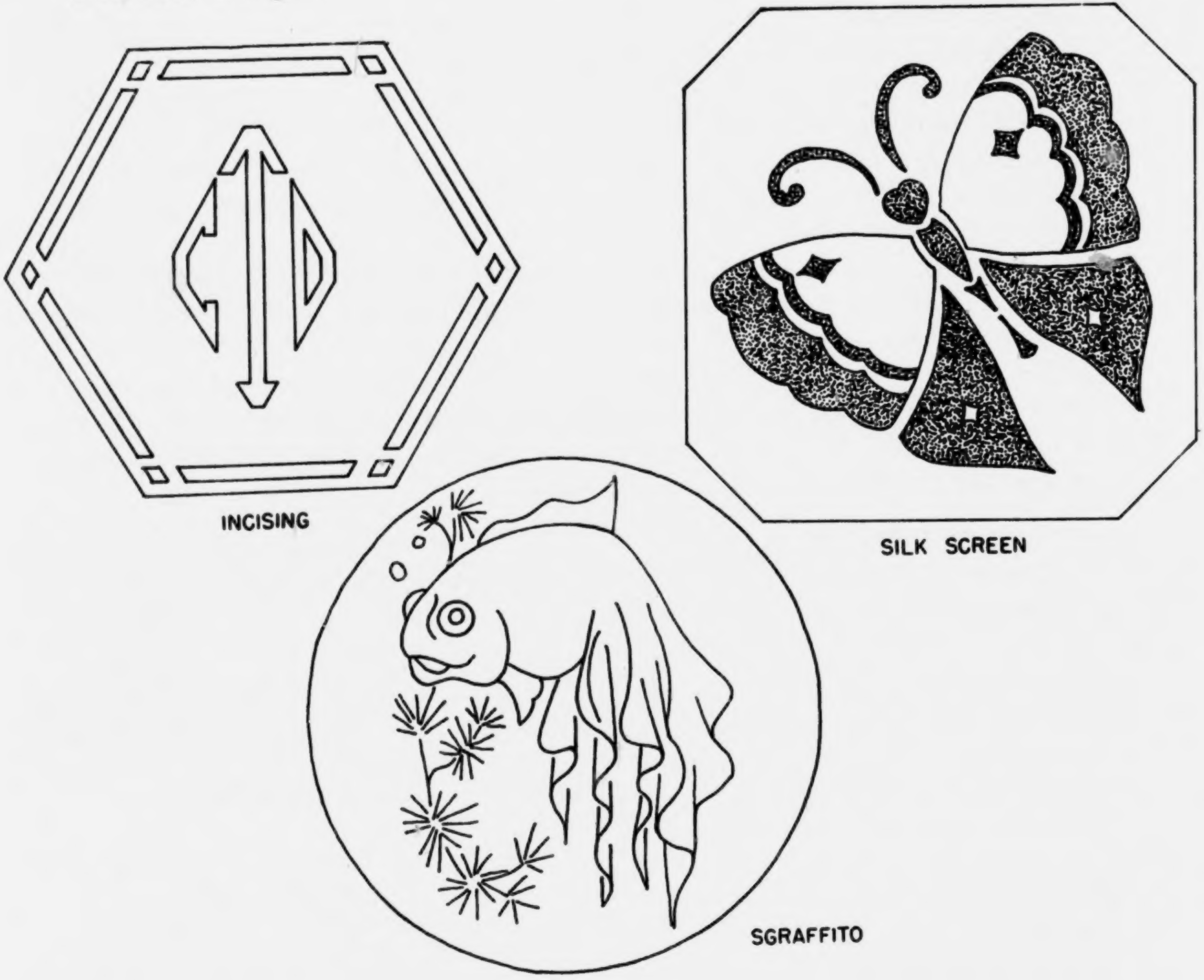
Working Drawing


4"-6"
TAPER SIDES ABOUT 5°
$\frac{1}{8}$ R
$\frac{5}{8}$"
$\frac{1}{4}$"
$\frac{1}{2}$"
$\frac{3}{4}$"
$\frac{3}{8}$"

SURFACE DESIGN

BACKGROUND	BLUE-GREEN
TIE	YELLOW
NOSE, HAIR, DOTS IN TIE, HAT BAND	RED
HAT	YELLOW
ALL OUTLINE	BLACK
FACE	WHITE
DOTS IN TIE, HIGHLIGHTS IN CHEEK	SGRAFFITO

Alternate Designs



Research Activities

Examine and measure articles which are to be set on tile to determine the best size and shape to use.

Develop and experiment with different kinds and types of glaze for resistance to scratching, and the effect of textures in regard to surface friction.

Sketch on paper possible designs to be applied to the tiles.

Look at commercially made tiles to see how they are made to reduce warpage.

Procedure

Make several drawings of desired shapes and patterns, selecting one which will best meet its need of usefulness.

Prepare a full-size paper pattern, allowing for shrinkage.

Roll out a slab of plastic clay to the desired thickness. Do this on oilcloth to prevent sticking. Use thickness sticks to insure an even thickness throughout.

Place pattern on slab and cut out.

Gouge in several panels about one-third their thickness using a wire loop tool. This should prevent warpage during drying.

Dry between plaster bats or pieces of glass.

When leather hard, smooth all surfaces.

When bone dry, the decoration effect may be applied.

Bisque fire, glaze, and glaze fire.

Related Technical Information

Causes of Warpage:

There are three principal reasons for warping during the drying process.

Nonuniformity of the structure, that is, one portion of the object consists of well-aligned particles, while the particles in the rest of the piece are arranged in a helter-skelter fashion. This type of warpage usually takes place in pieces which have been cast in single-piece molds where one surface is in contact with plaster and the other is not.

The strains set up in handling the plastic or nearly dry piece are a second cause of warping. These strains, which may not be immediately visible, will cause serious warping in the later stage.

Uneven drying also causes considerable warpage. This is one of the most common and most annoying faults in making flat pieces. Always apply damp cloth or, if possible, cover both sides with a plastic bat. This will allow water to be removed slowly and evenly into the plaster.

Other topics to explore:

Removal of Chemical Water
Drying Shrinkage

Demonstrations

Roll clay into slabs.
Form a tile.
Incise or decorate by carving.
Pack kiln for bisque firing.

Related Cultural Information

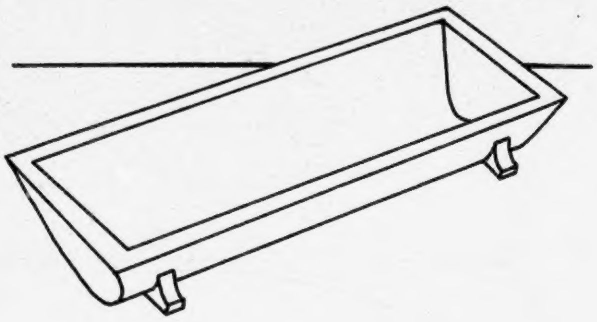
Records on Tile:

Hundreds of clay tiles have been found which bear records of the history of the nations which at different times controlled the valley of the Tigris and Euphrates. In fact, tiles, or tablets as they were called, have been found by archaeologists in buildings which resembled our own libraries. In place of books, there were rows and rows of clay tablets ranging in size from 2-inches square to as large as 6 inches by 16 inches. Many messages, business transactions, records of wars, and orders from the king had been passed along on clay tiles just as we do today with paper.

References

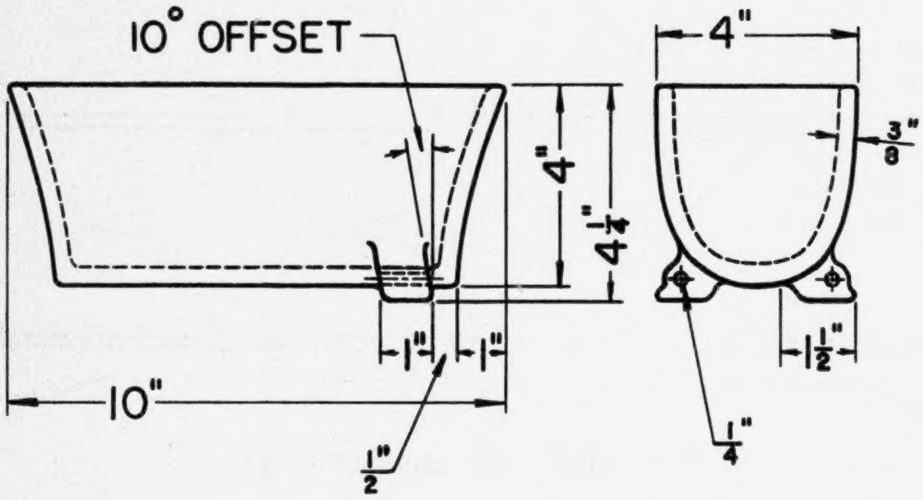
Norton, F. H. *Ceramics for the Artist Potter*. pp. 209-213
Stiles, H. E. *Pottery of the Ancients*. pp. 34-40

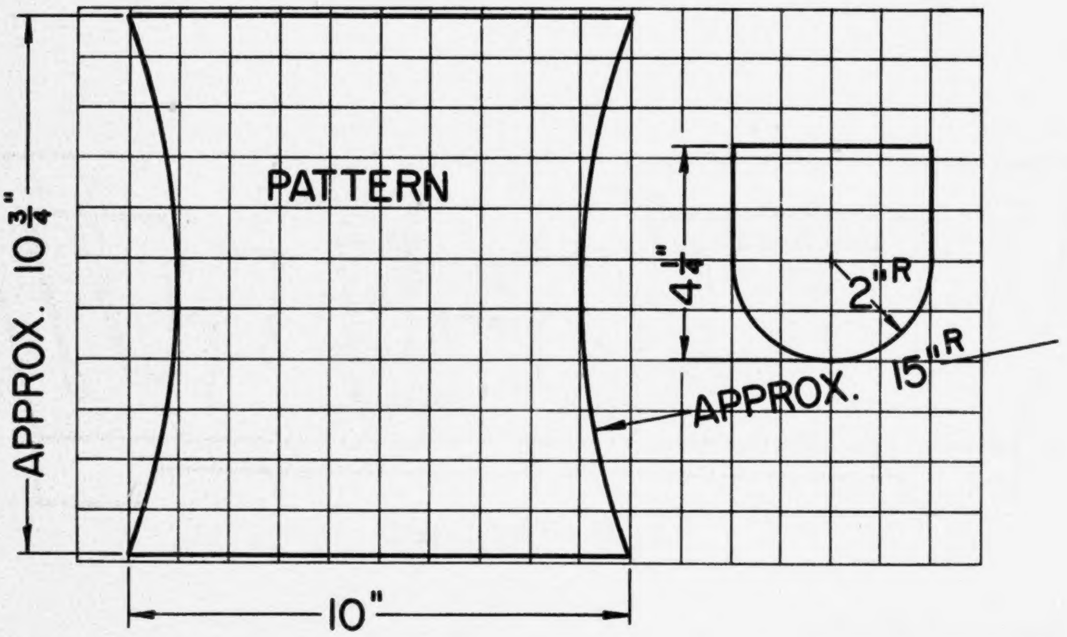
PLANTER



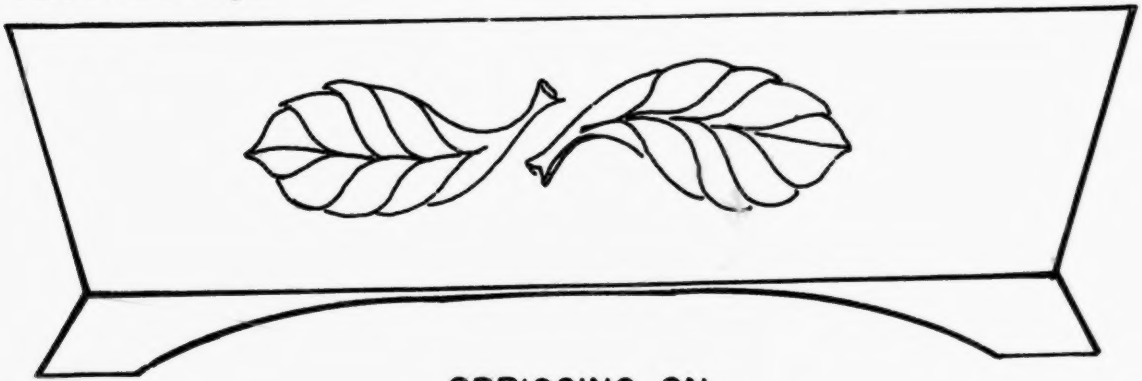
This planter is designed as a dual-purpose project in that, with very little altering, it may be used either on tables, window ledges, fireplace mantels, or suspended from walls, windows, or arches.

Working Drawing

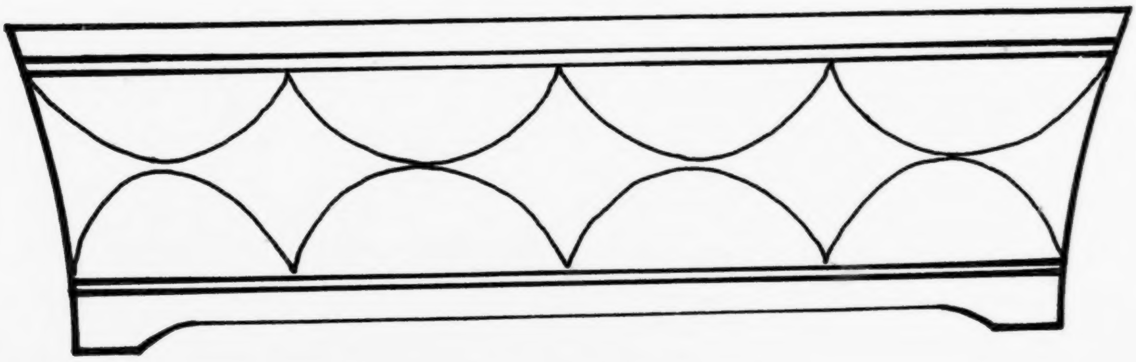

10° OFFSET
4"
4"
4 1/4"
3/8"
1"
1"
10"
1/2"
1 1/2"
1/4"


PATTERN
APPROX. 10 3/4"
10"
4 1/4"
2"R
APPROX. 15"R

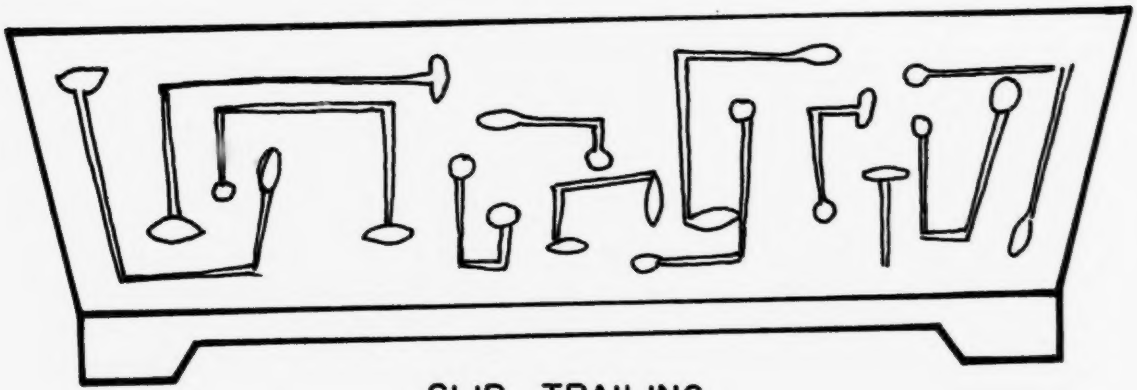
Alternate Designs



SPRIGGING ON



INCISING OR SGRAFFITO



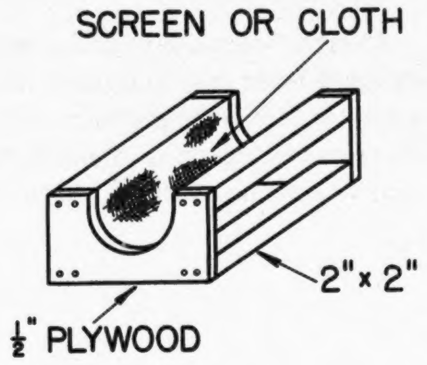
SLIP TRAILING

Research Activities

The size and shape of flowers and plants are two of the determining factors affecting the basic design and function of planters and pots. Refer to several gardening magazines for ideas as to arrangement and display which might act as a guide in developing planter variations.

Procedure

Lay out paper pattern.
Develop sling. (See figure 1.)
Prepare clay.
Roll slab.
Cut to pattern.
Dry in sling until stiff.
Remove from sling and place feet in position.
Dry to leather hard, fettle smooth.
Decorate by sgraffito, slip trailing, or sprigging on.
Bisque fire.
Apply glaze.



SLING

FIGURE 1.

Related Technical Information

Drying of Ware:

All ware must be bone dry before firing. If attention is not paid to this paramount rule, disaster will result in that all one's effort may be undone.

Because of the thickness of the clay, the surface moisture will be extracted first and the piece will appear dry. However, it will feel cold to the touch. If fired at this time, the moisture within the clay becomes steam which will expand with terrific pressure and crack or explode the ware. Hence the important rule is to make sure the ware is bone dry before firing in the kiln.

Another topic to explore:

Methods of Drying Ware

Demonstrations

Lay out and make pattern or template.
Application of appendages.
Sgraffito decoration.

Related Cultural Information

Grading of Ceramic Ware:

First quality ceramic ware is selected according to a standard called RK, or RK Selects, by the manufacturing trade. Run of Kiln (RK) includes all ware of first quality according to the above standard. After each step in manufacturing, pieces of ware go through a process of selection, in which the crooked or defective ware is culled out. It is a very difficult matter to produce perfect clayware, because with so many different processing steps, many things can go wrong. Therefore, it is customary for RK grade to contain a few less-than-perfect pieces in addition to perfect ware or selects.

Other topics to explore:

How Dinnerware Is Sold
Range of Clayware Offered

References

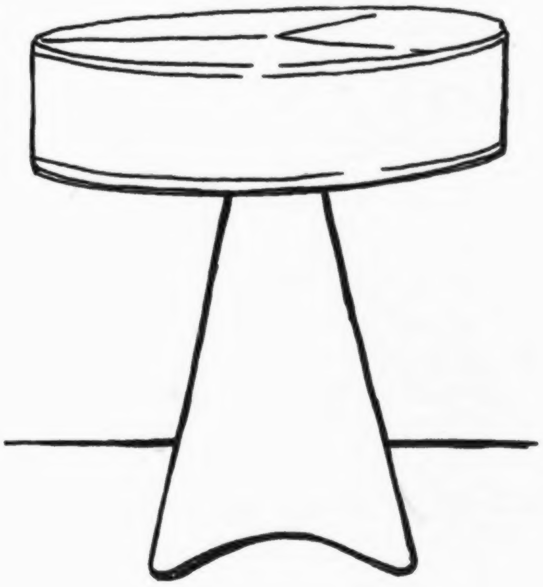
Hyman, N. R. *Ceramics Handbook.* pp. 48-64

Taylor, Sally. *Ceramics for the Table.* Chapter I

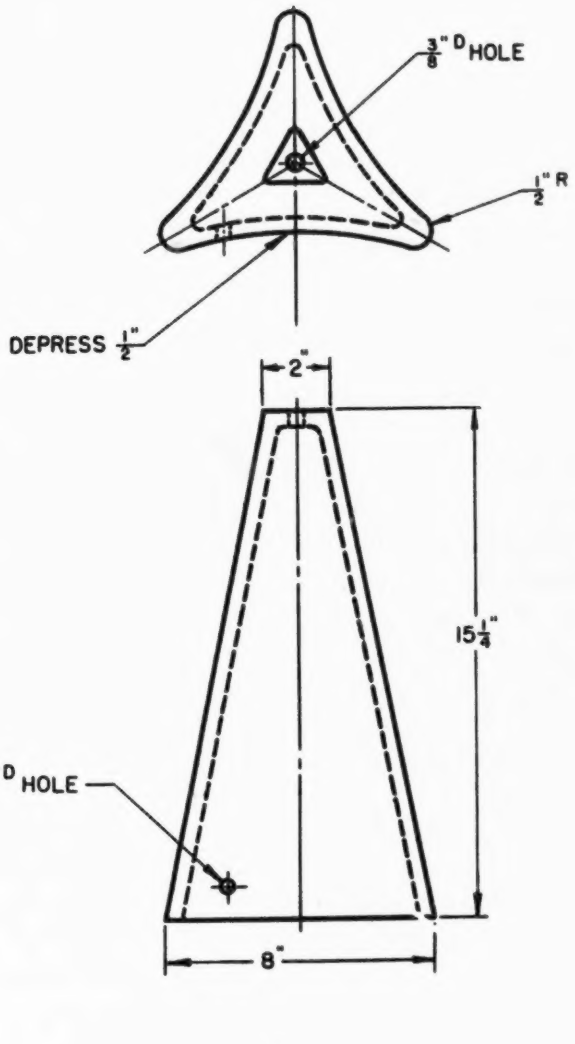
The University of the State of New York. *Ceramics Area Related Information.* p. 103

LAMPS

Lamps, especially table lamps, constructed from clay slabs are always interesting to design, construct, and decorate. They can be made to blend with any decorative scheme of the home or office.

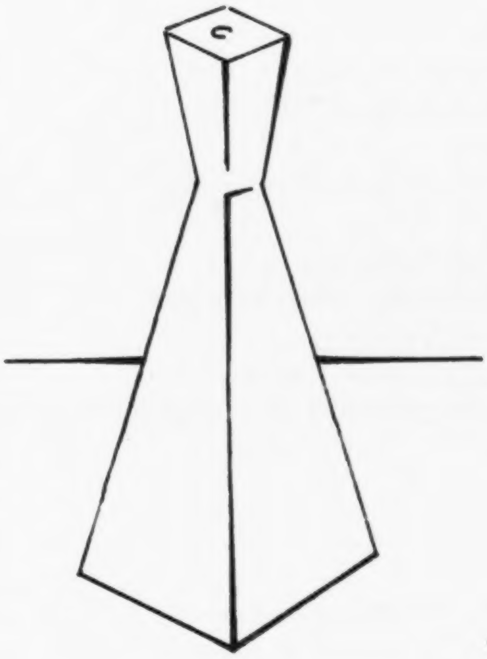


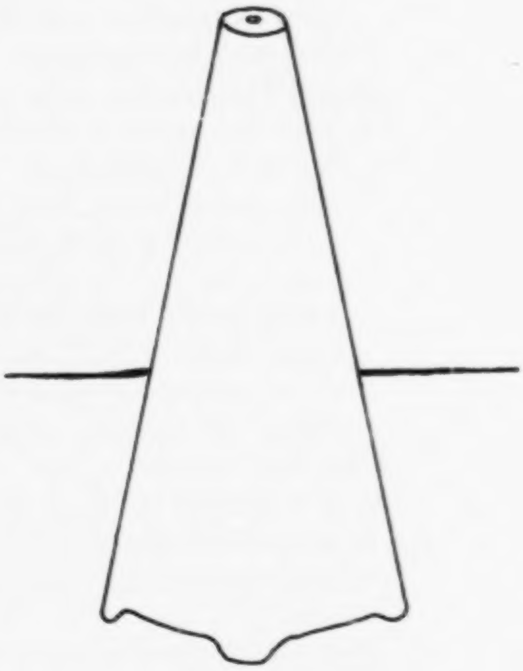
Working Drawing

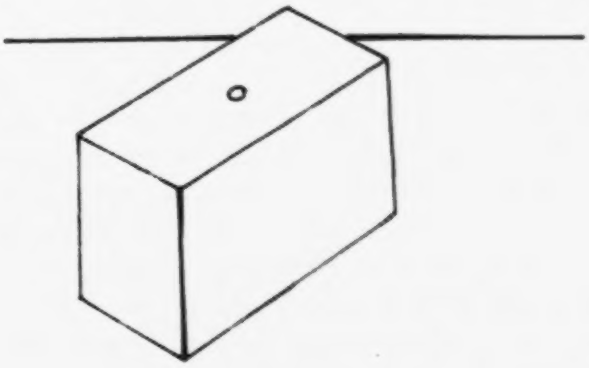


3/8" D HOLE
1/2" R
DEPRESS 1/2"
2"
15 1/4"
1/4" D HOLE
8"

Alternate Designs







Research Activities

Select other pieces of furniture about your home. Develop basic shape lamps which meet the fundamental design elements, yet offer you an opportunity to express your creative ability.

Develop shapes by cutting, bending, twisting, curling, and pasting heavy paper or cardboard to produce the effects desired. Develop templates for use in slab construction.

Look for interesting motifs to be used on lamps in small rooms such as game room or nursery.

Procedure

Develop a full-size paper drawing of each part, cut it out for a pattern.

Roll out slab of well-wedged plastic clay to the desired thickness. This lamp uses ⅜-inch thick slabs.

Place pattern on slab and cut out all pieces.

Score all edges to be joined, apply a layer of slip on each.

Carefully place sides in position. If cracks appear in the sides, smooth out with a wet sponge.

Weld all pieces together, using a rope of clay as a fillet on the inside. Bracing might be necessary at this point to prevent sides from collapsing.

Repeat above operation in securing top in position.

Smooth all seams carefully with modeling tool and sponge.

Test all joints for cracks, and make necessary adjustments to secure the desired shape. This must be done at this point, since shaping and twisting will crack ware if done after article becomes leather-hard.

Set the lamp aside to dry. To prevent warping, dry slowly.

When leather-hard, fettle smooth and apply proper decorating technique.

Drill ½-inch hole in top for socket fixture and ¼-inch hole near bottom back for cord exit.

Lamp is now ready for bisque fire. This should be a slow heat as a precaution against additional warping.

Apply appropriate glaze leaving inside and bottom unglazed. Glaze fire.

Attach all electrical fixtures, cord, and plug, making necessary tests for open and short circuits.

If additional weight is needed for stability at the base, fill partially with newsprint and then plaster of paris at bottom. Caution should be exercised to prevent twisting or puncture of electrical connections.

Related Technical Information

Applying Underglaze Colors:

Streaks in underglazes or engobes are often the fault of not using enough coats of color. When colors placed on greenware and bisque fired before glaze application, one can check color application by placing the fired bisque underwater for a second and noting any areas not having the desired appearance. Retouch those areas with color before applying the glaze. After the glaze has been applied, corrections cannot be made. This characteristic of underglaze streaking can be used to very good advantage in designs as well as backgrounds. Even sponging of the greenware to obtain slight all-over dampness may aid in the control of underglaze colors, but care must be taken not to get wet spots. When sponging immediately before the application of the underglaze colors, the ware should be evenly damp.

Other topics to explore:

Poor Color in Colored Glaze
Pin Holes in Glazed Ware

Demonstrations

Decorate with underglaze colors on bisque body.
Apply glaze by spraying.
Fire glazes and record results.
Build pottery within limits set by template.

Related Cultural Information

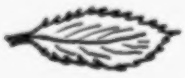
Potter's Marks:

Usually all potters, beginners, artists, professionals, and even commercial factories use marks to distinguish their wares. Marks may refer to any one of a dozen different things; the name of the factory, the name of a manager of a factory, the name of an artist, the name of a town, the name of a certain potter, a series date, a formula of one sort or another, the trademark of a merchant, an intended owner's name, or a multitude of other things. Thus, in many instances in the study of ceramics, the meaning of marks will vary from person to person and year to year.

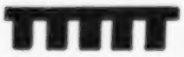
One of the major considerations in identifying a mark is its style. Usually the style influence can be identified as a piece of Chinese, Japanese, or European. The style influence does not necessarily mean that the piece was made in that country. Recently American potteries have been producing wares of all styles, however, if a factory or individual in America were producing Swedish-styled ware, it would be quite possible to find a Swedish influence in the mark.

Many marks are very closely associated with people of certain areas, and include many symbols common to that area.

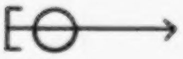
Some of the more common marks used by potters of different countries are shown below. Many incorporate the symbols of their country into their own personal marks.



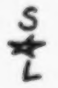
CHINESE LEAVES



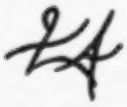
JAPANESE FACTORY MARK



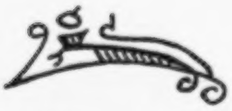
ENGLISH POINT OR ARROW



GERMAN AND SWEDISH LETTERS, LINES AND DOTS



ITALIAN AND FRENCH FREE FLOWING LETTERS



AMERICAN, MODERN

Many references have been published showing marks and identification methods. Among these are:

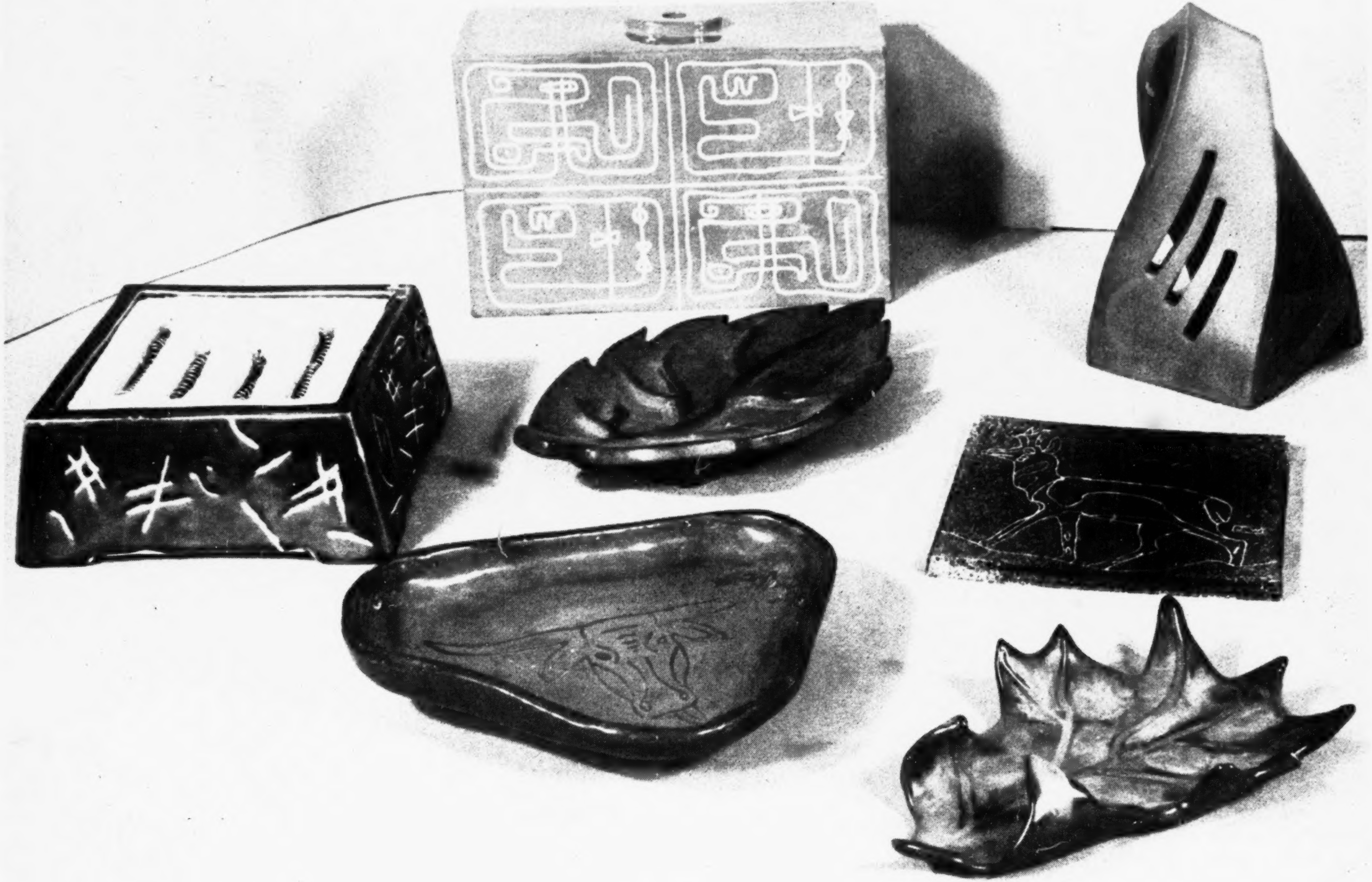
American Potters and Pottery. pp. 161-275
Pottery and Porcelain. Volume II. pp. 1,081-1,150

Other topics to explore:

Identification of Antique Pottery by Marks
Develop Your Own Potter's Mark

References

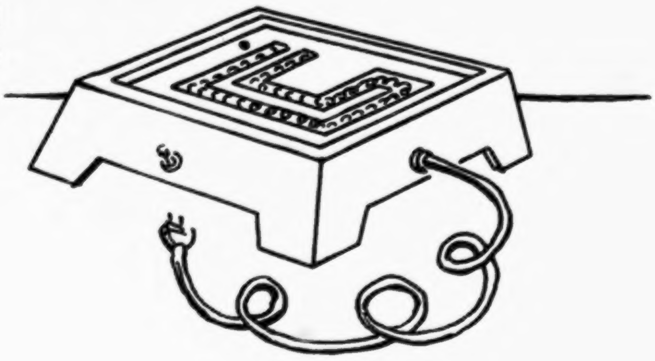
Cox, W. E. *Pottery and Porcelain*. Volume II. pp. 1,081-1,150
Kenny, J. B. *The Complete Book of Pottery Making*. pp. 23-27
Norton, F. H. *Ceramics for the Artist Potter*. pp. 14-18
Olsen, D. W. *Pottery*. pp. 29-31
Ramsey, John. *American Potters and Pottery*. pp. 161-275



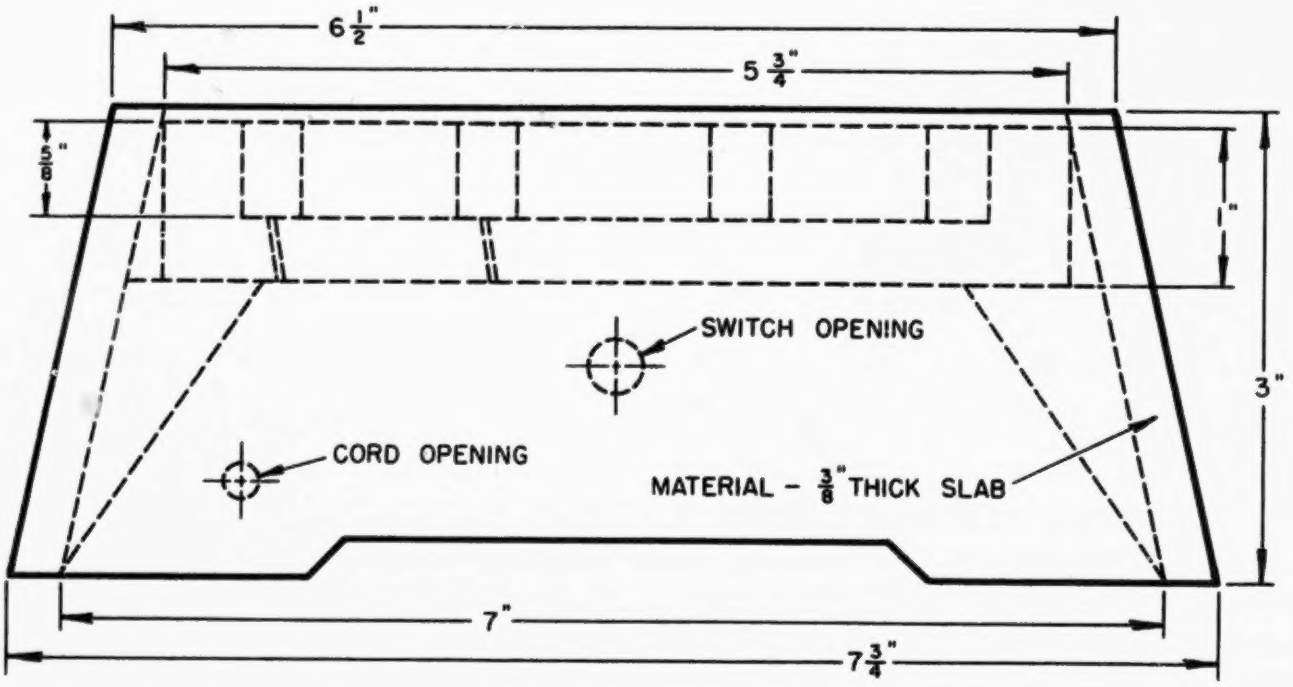
Articles formed and constructed from slabs.

ELECTRIC HOT-PLATE

This is a very useful project which will work satisfactorily at home or camp as a coffee-maker, heater, baby bottle warmer, or auxiliary stove for the kitchen.



Working Drawing

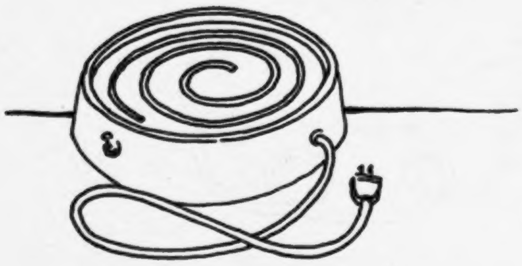

6 1/2"
5 3/4"
5/8"
1"
3"
SWITCH OPENING
CORD OPENING
MATERIAL - 3/8" THICK SLAB
7"
7 3/4"

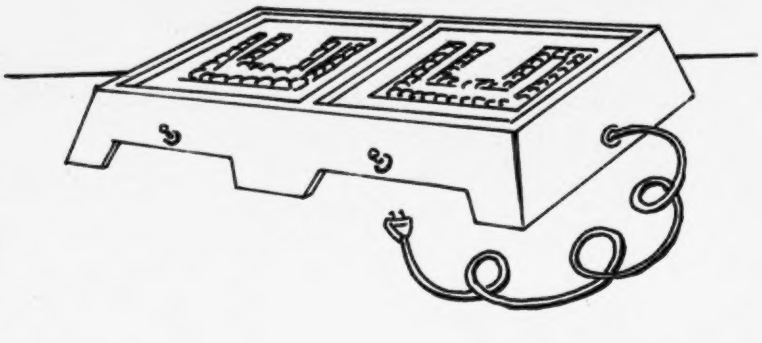
NOTE: DIMENSIONS FOR SIDES (2) AND ENDS (2) ARE IN THIS VIEW

Bill of Material

1 Clay slab, 3/8-inch thick x 6 inches wide x 15½ inches long
1 Piece nichrome "A" wire, No. 22, 8 feet long
1 Firebrick, K-23
1 Toggle switch, 15 amp., 115 volt
2 Wire connectors, porcelain (small)
1 Piece asbestos heater cord, No. 18, 8 feet long
1 Rubber plug

Alternate Designs





Research Activities

Examine commercial hot-plates for design features.

Test using two heating elements with high and low heats.

Test various materials for their resistance to heat.

Procedure

Prepare good warp-free clay.

Roll out slab of desired size. (See *Pottery Made Easy*, p. 30.)

Cut and weld all joints.

When leather hard, smooth and drill necessary holes.

Bisque fire.

Saw firebrick into two 1-inch slabs. (See figure 1.)

Cut width and length to fit opening.

Lay out, cut element grooves to ⅝-inch depth, drilling a small hole at points where wire enters. (See figure 2.)

Dowel and cement firebrick together with refractory cement.

Wind element on 3/16-inch dowel, leaving 2 inches straight at each end.

Insert in holder.

Secure snug fit between stand and holder by filing to size.

Glaze fire stand only.

Apply felt to feet bottoms.

Install switch and cord, secure nichrome with porcelain connectors. (See wiring diagram.)

Test circuit, using low voltage.

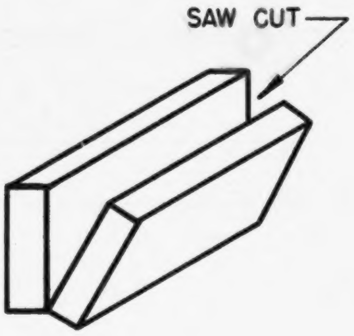


FIGURE 1.

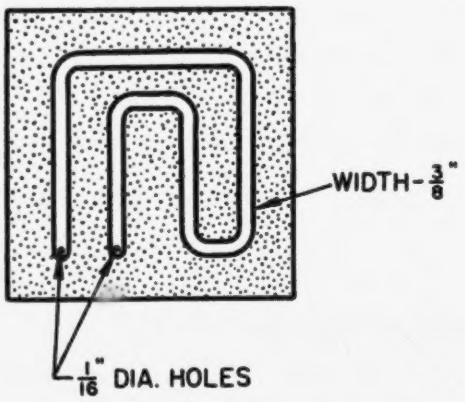
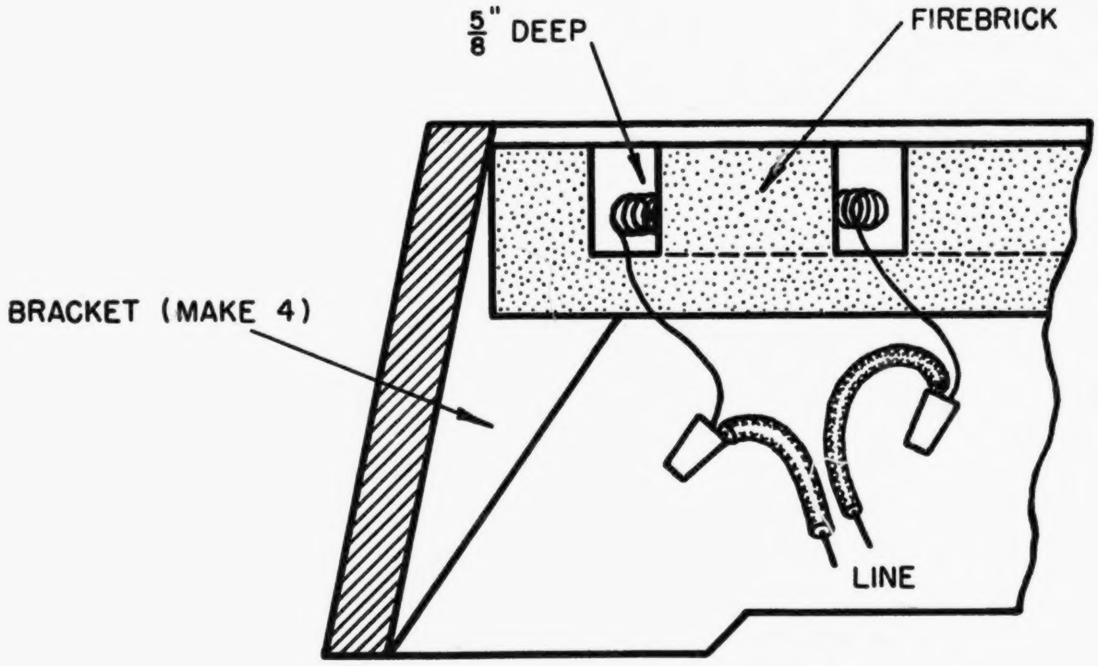


FIGURE 2.

Related Technical Information

Porcelain and Thermal Shock:

Ceramic ware will usually crack when exposed directly to an open flame. This cracking action is due largely to thermal shock. When pottery is to be used over



WIRING DIAGRAM

an open flame it should be a high-fire porcelain body which will resist sudden changes of temperature. Porcelain bodies of this type are used for spark plugs which must withstand the sudden heat of combustion in the engine's cylinder.

Other topics to explore:
- Clay Changes During Firing Cycle
- Chemical Compounds Commonly Used as Ceramic Raw Materials
- Estimate Shrinkage in Drying Clay Bodies

Demonstrations

Prepare hand-building template, stress allowances for shrinkage.
Stack kiln for bisque firing.
Correct a clay which warps or cracks.
Weld clay joints.

Related Cultural Information

First Use of Pottery:

No one knows when or how it was discovered that fire would harden clay; but the first pottery seems to be associated mainly with agricultural people. It came into general use in Europe with the arrival of the New Stone Age peoples about 12,000 years ago. They coated containers of wood, skin, or wicker with clay before cooking their family porridge, which resulted in a hard clay shell being formed in their fire pits.

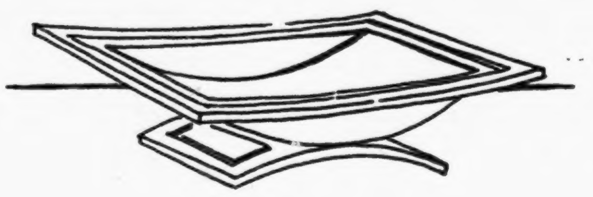
Other topics to explore:
- New Stone Age People
- Primitive Pottery of South America

Reference

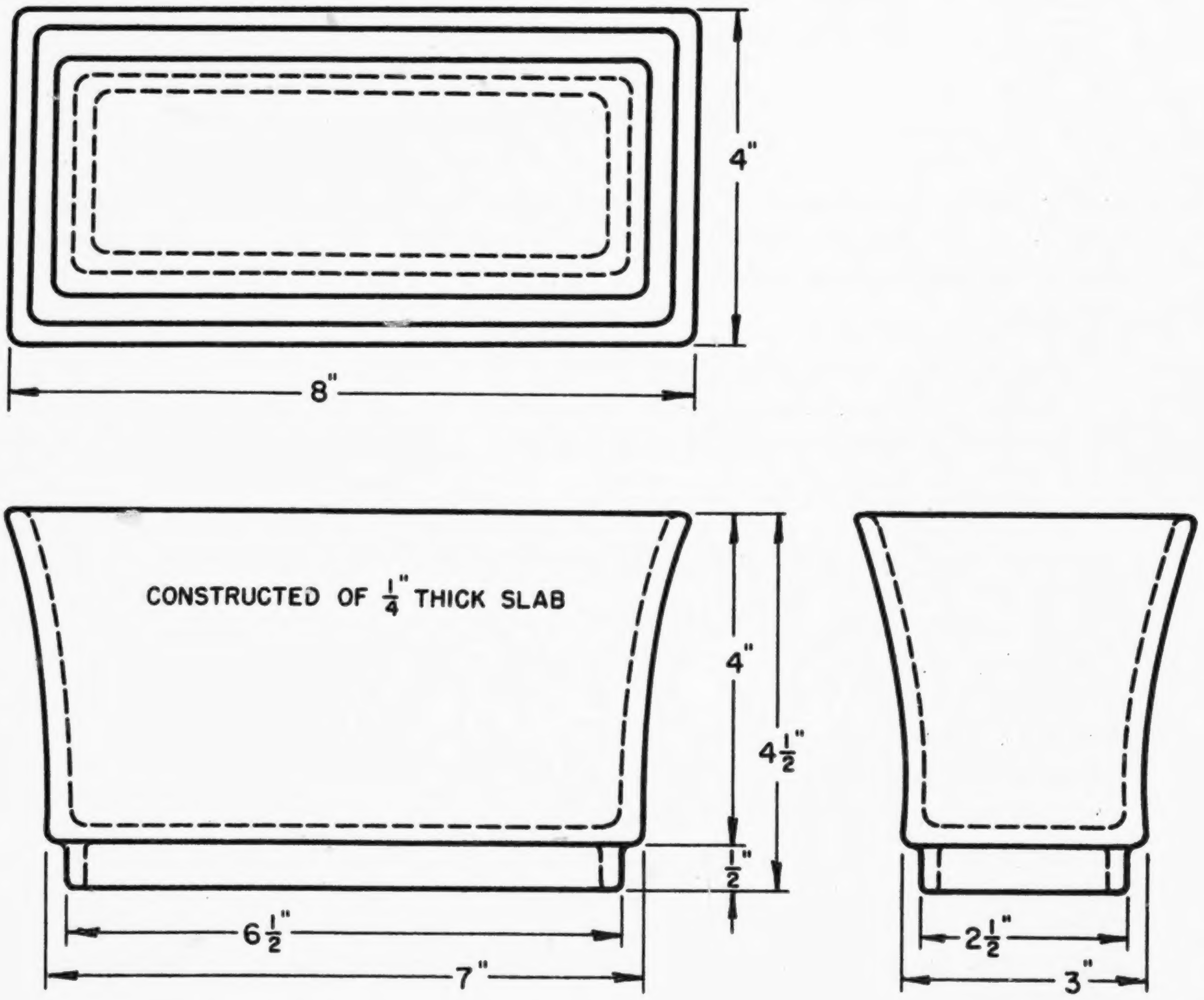
Dougherty, J. W. *Pottery Made Easy*. pp. 30-31.

FLOWER VASE

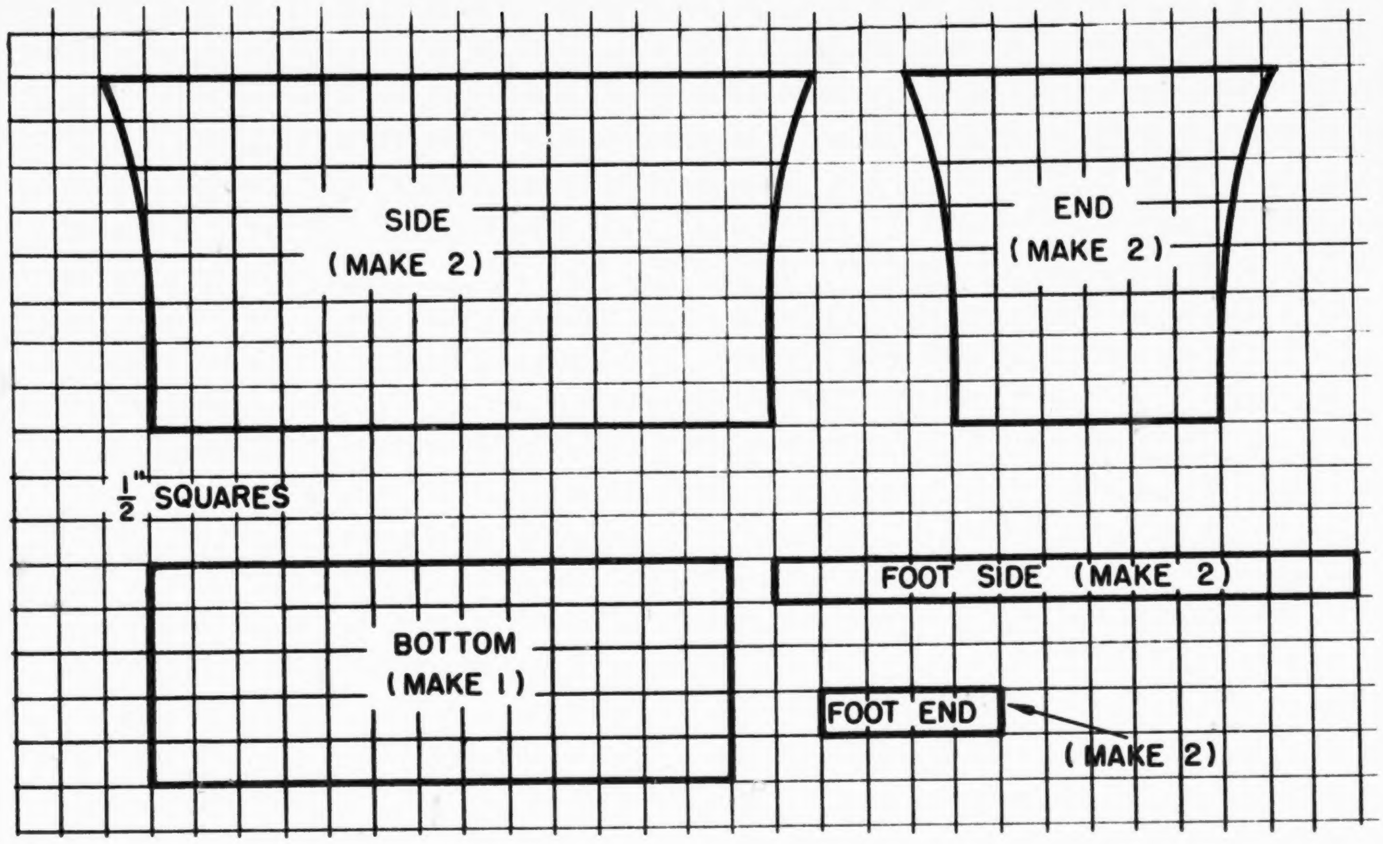
Slab building is a lot of fun. The method can be used to make a variety of pottery vases, to which are applicable a wide range of surface decoration techniques.



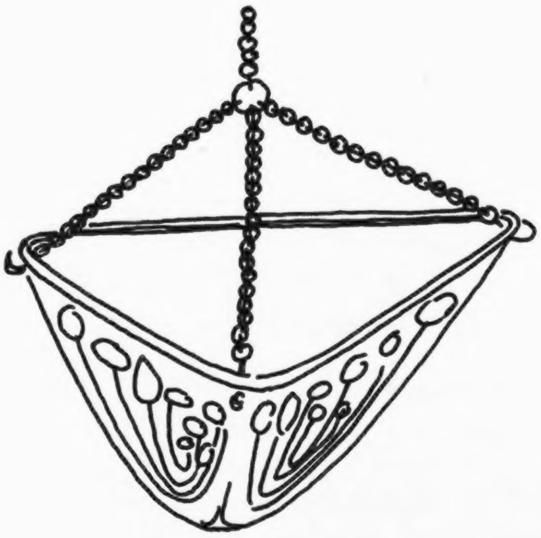
Working Drawing


4"
8"
CONSTRUCTED OF $\frac{1}{4}$" THICK SLAB
4"
4$\frac{1}{2}$"
$\frac{1}{2}$"
6$\frac{1}{2}$"
7"
2$\frac{1}{2}$"
3"

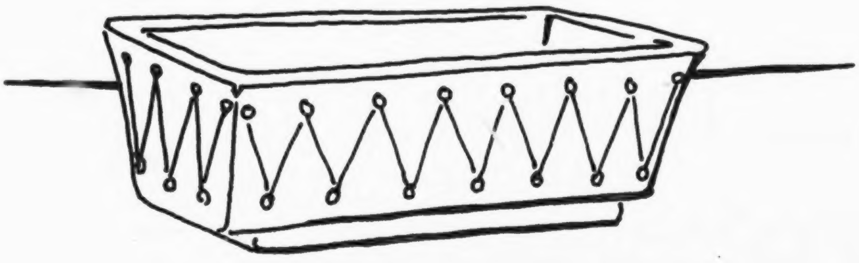
Pattern


SIDE
(MAKE 2)
END
(MAKE 2)
$\frac{1}{2}$" SQUARES
BOTTOM
(MAKE 1)
FOOT SIDE (MAKE 2)
FOOT END
(MAKE 2)

Alternate Designs



INCISED LINES



SLIP TRAILED

Research Activities

Explore the possibilities of decorating with glaze. Practice applying glaze by dripping, spraying, pouring, brushing, spattering, swirling, and sponging one or more colors over a base glaze. Record on back of test tiles method and ingredients for future reference.

Procedure

Wedge clay.

Roll out slabs to size, approximately ¼-inch thick.

With patterns and straight edge, cut out parts. Keep flat until joining.

Roll out ¼-inch diameter rope to use as fillet on all inside corners.

Weld sides and ends to bottom slab, then sides to ends.

With piece upside down, weld foot in position.

Straighten sides, bottom, and ends, brace with wads of clay to prevent sagging.

Let piece dry to leather-hard, then fettle all edges and surfaces.

Round all corners and edges with ⅛-inch radius.

Decorate, using sgraffito technique. Keep design simple. A fork will produce an interesting decorative effect if not overdone.

Dry completely, but slowly to prevent warpage.

Bisque fire.

Glaze, then glaze fire when dry.

Related Technical Information

Underfired Glazes:

Some glazes are transparent, making it possible to look through the layer of glaze and see the clay body or slip colors underneath it. Transparency is reached when the glaze is fired to maturity and all the oxides in its composition reach a state of complete fusion. Many glazes, however, even though they contain no opacifying agents are cloudy and sometimes rough textured. Underfired glazes, for example, have a frosted appearance because of the lack of complete fusion. If firing is halted before the glaze is completely melted, some unmelted materials may cloud the glaze in the way that dirt added to water makes an opaque, muddy mixture.

Glazes which are underfired will usually clear up and become transparent if the firing proceeds to the point of completely fusing the glaze.

Other topics to explore:

Differing Indexes of Refraction
Development of Crystals in Glaze

Demonstrations

Use grog in clay bodies.

Stack a kiln for bisque fire.

Mix and prepare glaze.

Decorate by carving leather-hard surface.

Use a pattern in checking accuracy in hand-building process.

Form and finish a foot.

Related Cultural Information

Design:

Design is the intended arrangement of materials to produce a certain result or effect. In the visual arts of drawing, painting, sculpture, and architecture the principles of design are most clearly seen.

The ceramist works with lines, shapes, colors, and textures. He is concerned with direction of lines, the size of the shapes, the shading of the colors, and the surface textures. He tries to arrange all these elements into a pattern that will seem emotionally satisfactory. If this effect is obtained, his design will have unity.

Other topics to explore:

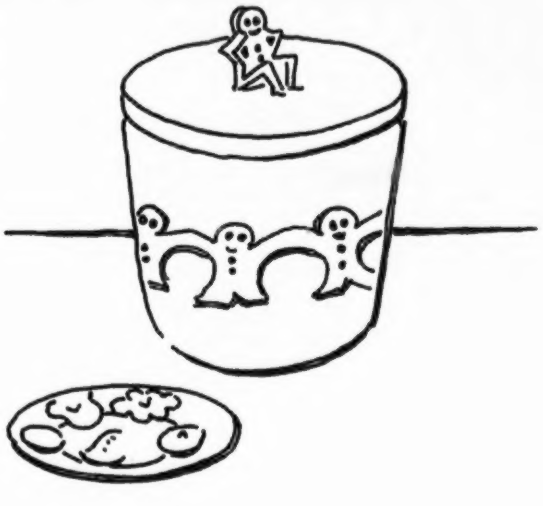
Proportion and Rhythm

References

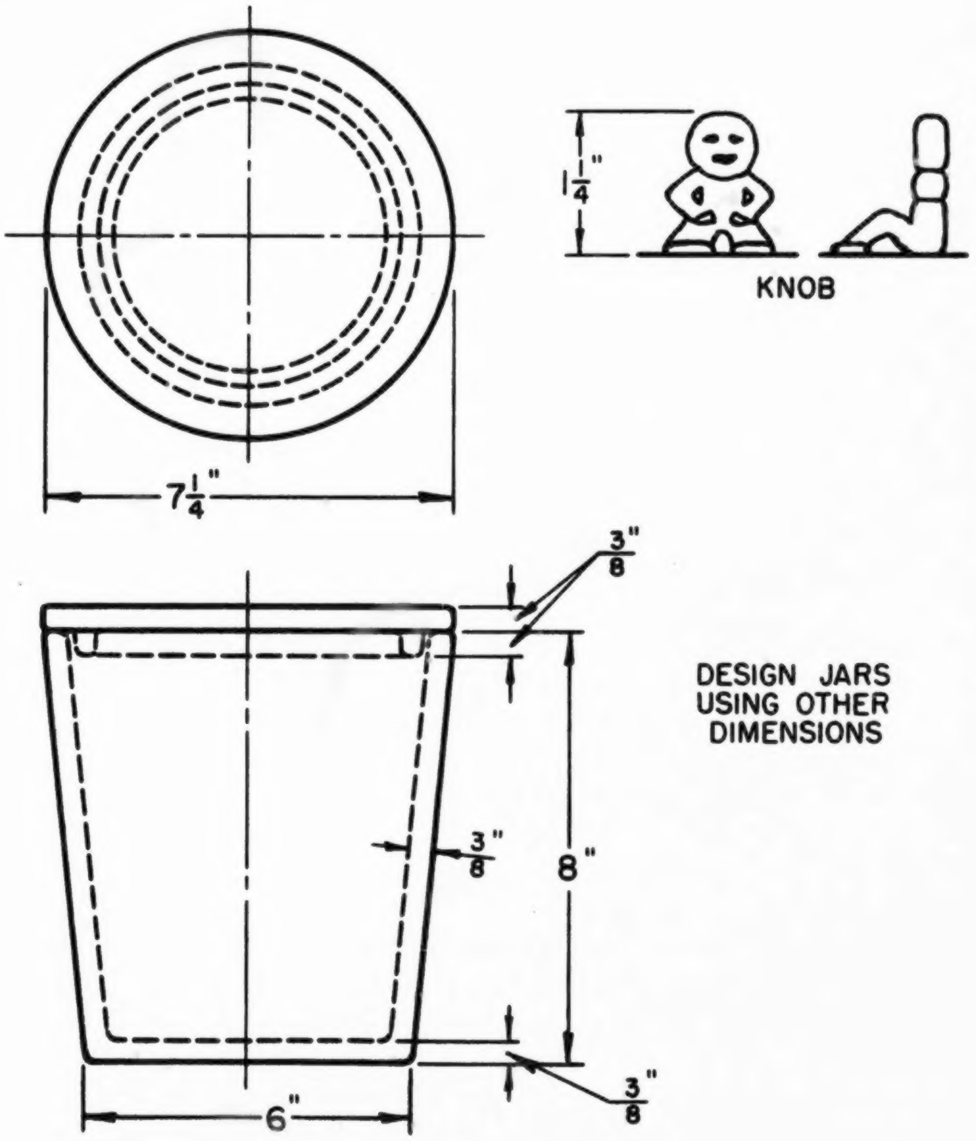
Kenny, J. B. *The Complete Book of Pottery Making*. pp. 23-25
Parmelee, C. W. *Ceramic Glazes*. p. 138
Rhodes, Daniel. *Clay and Glaze for the Potter*. p. 159
Scott, R. G. *Design Fundamentals*. pp. 1-9

COOKIE JAR

A most desirable and yet simple slab construction project is the cylindrical cookie jar with cover, big enough to hold an adequate supply of the family favorites.

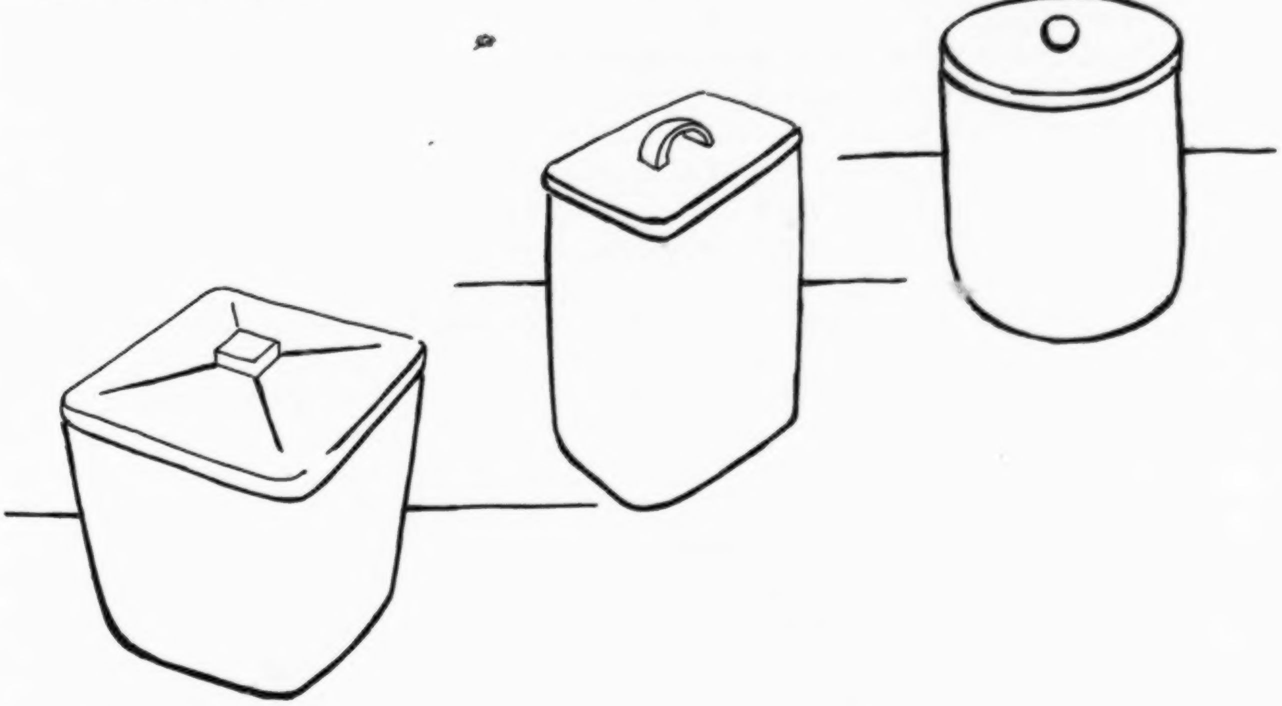


Working Drawing



DESIGN JARS USING OTHER DIMENSIONS

Alternate Designs



Research Activities

Search for containers which can provide other shapes and sizes.

Experiment with cardboard to form other types of supports for slab construction.

Experiment with stiff paper by folding or rolling it to produce new shapes.

Procedure

Obtain a 1-gallon cardboard paint mixing bucket.

Roll out clay slabs for top, bottom, and wall.

With the container, mark and then cut circular clay slabs for base and cover.

For the wall, place container on its side and roll one complete revolution across the clay slab. Cut along the container marks. The actual length needed is determined by placing slab in the bucket. Where the clay overlaps it is trimmed at a slight angle. (See figure 1.)

To assemble base and wall, score all adjoining surfaces.

Place base circle in bottom of container and apply slip to scored surface.

Apply slip to all scored edges of wall slab, form into tube, and lower into bucket.

Carefully weld the base joint and vertical seam.

Trim off all excess clay. Set aside to stiffen.

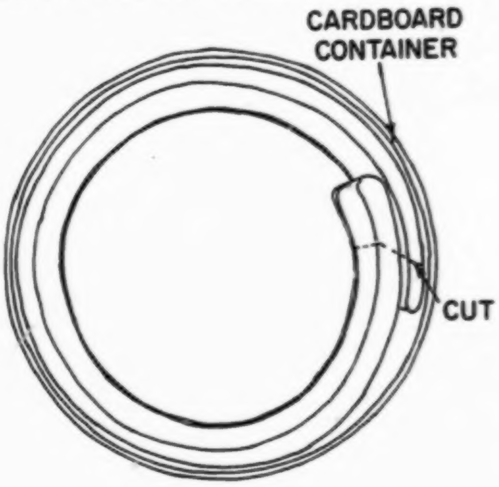


FIGURE 1.

For cover, form a clay coil and join it to underside of remaining circular slab for a retaining ring. Its diameter must fit within opening of jar.

From additional clay slab, form handle and weld to cover.

Remove jar from bucket and fettle both jar and cover.

Dry slowly and carefully.

Bisque fire.

For decoration, use majolica technique—gingerbread man design.

Glaze fire.

Related Technical Information

Majolica Glaze:

Majolica or maiolica decoration can be defined as "in-glaze decoration," wherein an unfired, opaque, tin enamel glaze serves as a ground upon which colored glazes are painted. The fired combination presents an appealing colored design actually fired into the glaze. The tin enamel glaze should be one which doesn't run when fired. The tinting glazes can be made by adding color oxides to the same tin enamel base glaze. Commercial underglazes may be used also but should be tested first.

The application of the color design may be facilitated by hardening the surface of the dry base glaze either by the addition of water base wall paint emulsion; or by spraying some suitable gum, such as gum arabic or methyl cellulose, over the surface prior to coloring.

Demonstrations

Develop layout from support container.
Fit clay slab to interior of container.
Weld joints of jar while in container.
Make cover to fit jar opening.
Apply majolica decoration.

Related Cultural Information

Majolica Ware:

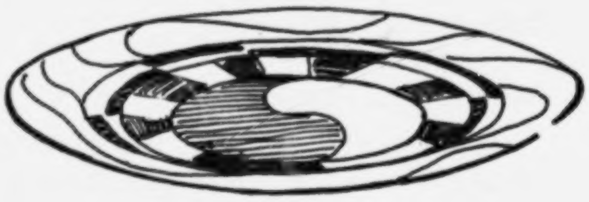
Majolica ware can be traced to the pottery of the Moors of the 15th century on the island of Majorca off the coast of Spain. Though appearing earlier in the Near East, the technique was not developed because of the scarcity of tin. The Moorish potters on Majorca with their Near East heritage and tin readily available from Spain developed and exploited the technique. Trade and Italian Holy Wars against the Moors introduced majolica ware into Italy. In Italy this introduction came at the beginning of the Renaissance and was readily accepted, adapted, and refined to the extent that majolica is often thought to have originated there.

French faience and Dutch delft are outgrowths of Italian majolica. The very name faience was derived from Faenze, an Italian city in which majolica ware was produced.

References

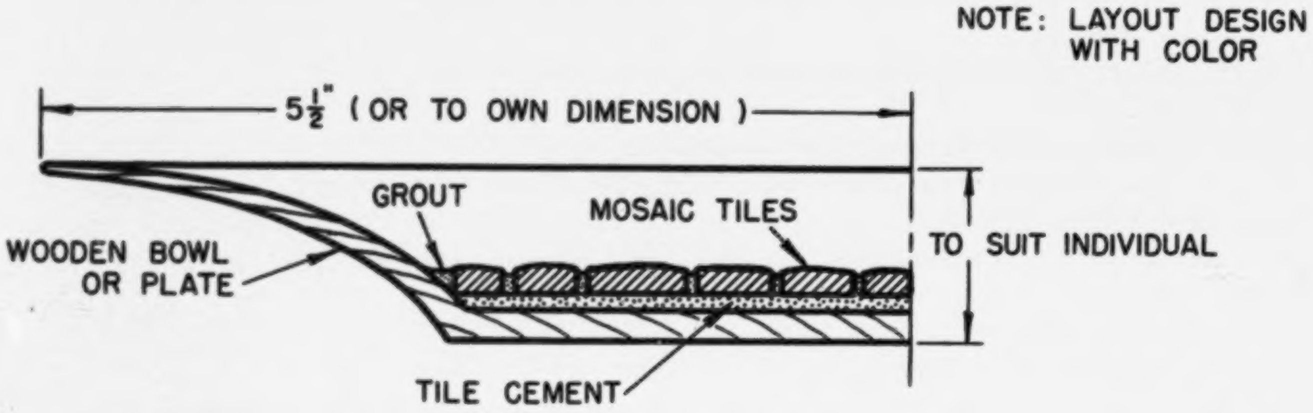
Rhodes, Daniel. *Clay and Glazes for the Potter*. pp. 168-169
Stiles, H. E. *Pottery of the Europeans*. Part I. p. 5

MOSAIC TILES

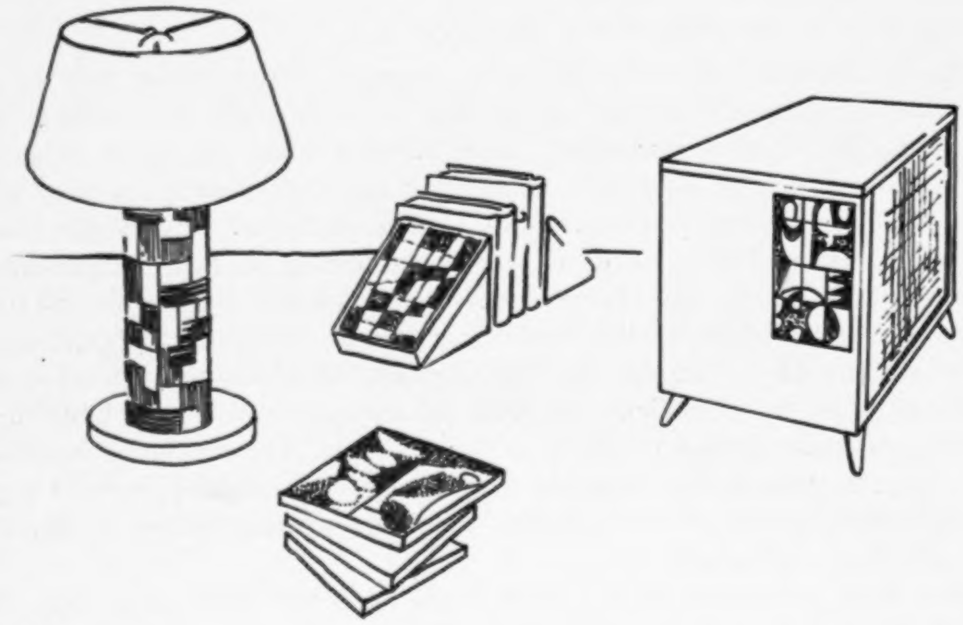


Many varied uses of mosaic tile are possible ranging from floor and wall application to counter tops, water-resistant shelves, and window sills. As decoration and useful parts of free standing furniture, such as screens, room dividers, coffee tables, end tables, bar tops, planters, and aquarium tables, mosaic tiles are both functional and pleasing. Many smaller items are suitable for mosaic tile application such as lamp bases, trivets, book ends, trays, and bowls of varied shapes and sizes.

Working Drawing


NOTE: LAYOUT DESIGN WITH COLOR
$5\frac{1}{2}''$ (OR TO OWN DIMENSION)
GROUT
MOSAIC TILES
TO SUIT INDIVIDUAL
WOODEN BOWL OR PLATE
TILE CEMENT

Alternate Design



Research Activities

Design a mosaic table top.
Adapt a design for a mosaic mural.
Devise other methods of making ceramic mosaic tile.
Experiment with other adhesive materials for cementing tiles.

Look for other materials suitable for use as grout.

Observe stained glass windows and adapt to tile.

Experiment with pieces of colored paper to develop patterns and designs to be duplicated in tile.

Procedure

Lay out desired bowl and mosaic design.

Make full size pattern of mosaic design.

Prepare and wedge clay.

Roll out slab of clay to ¼-inch thickness.

Lay pattern on clay and trace.

Cut through clay on traced lines.

Allow clay to dry leather hard.

Fettle, sponge, and dry pieces.

Apply underglaze colors as determined in original design.

Bisque fire.

Glaze pieces with clear transparent glaze.

Glaze fire.

Turn wood bowl to required dimensions.

Spread ceramic tile adhesive over area of bowl to be tiled. (See *Mosaics: Hobby and Art*. pp. 10-11.)

Imbed tiles in cement, adjust so that spaces between pieces are even.

Mix and fill spaces between tiles with grout.

Clean excess grout from tiles.

Finish bowl as desired.

Note: Small tiles for mosaic work can also be made readily by extruding using the extrusion press (see unit, Extrusion Press).

Related Technical Information

Preparation of Decorating Color Materials:

Prepared decorating color materials in ceramics, derived from metallic oxides, are of two types: single element colors, and the more stable dull element spinels. In the production of a satisfactory basic ceramic stain, the color elements, or spinels, combined with modifiers, fluxes, and dilutants, undergo a very exacting and carefully controlled procedure. Other oxides included to alter the shade are used as modifiers. Fluxes used to promote calcining at high temperatures are sodium chloride, borax, and phosphates. Dilutants used to lighten the color can be ground whiteware body, kaoline (raw or calcined), alumina, feldspar, and flint. The processing of a stain begins with carefully weighing or measuring all the ingredients. The dry ingredients are then intimately mixed. The soluble materials are added as concentrated solutions to form a paste. The combined materials are dried and remixed and then subjected to calcining. The resulting material is ground in a ball mill for as much as 450 hours. Repeated washing follows to eliminate all traces of soluble substances.

The stain is now ready for use, without any additions, either as a body, engobe, or glaze colorant in proportions from 1 to 20 percent.

With the addition of 5 percent of glaze for binding, and 5 percent clay as a suspender, the stain becomes an underglaze color. The addition of a variety of vehicles will adapt the material for almost any application technique. Fat oil, essential oils, gum arabic, glycerine, and sodium silicate as mediums, generally require a hardening or fire. Dilute glycerine usually does not require this firing.

These same stains when combined with low fusing frits and oil mediums become overglaze colors. The lower temperature range of this material makes possible the use of some colors not attainable at higher temperatures.

Another topic to explore:

Sources of Metallic Oxides

Demonstrations

Make a mosaic pattern from a design.
Cut mosaic tiles from a slab.
Apply underglaze colors.
Cement tiles with ceramic tile adhesive.
Mix and use grout.

Related Cultural Information

Mosaics:

Archaeological exploration in 5,000-year-old ruins of the valleys of the Tigris and Euphrates Rivers of Asia Minor has yielded what is considered the earliest examples of mosaic art. The mosaics were made of colorful fragments of stone imbedded in wood, bone, or ivory, and were used as jewelry or to embellish furniture or architecture. The Ancient Egyptians also used mosaics as a means of expression using shells, stone, marble, wood, ivory, and glass for their works of art. The actual manufacturing of "pieces" to be used for mosaics was a natural development of the limitations of color in natural materials like stone or marble. Glass and ceramic clay "tesserae," as the pieces are called, provided color in range and depth unavailable in nature. The art of mosaics reached a peak in Italy where church decoration was practically all mosaic work.

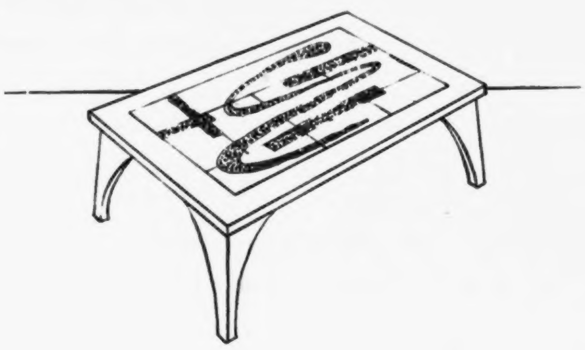
A new revival of interest in mosaic work is in evidence in our own era with wonderful examples appearing on public buildings and numerous applications of mosaics within our home.

Reference

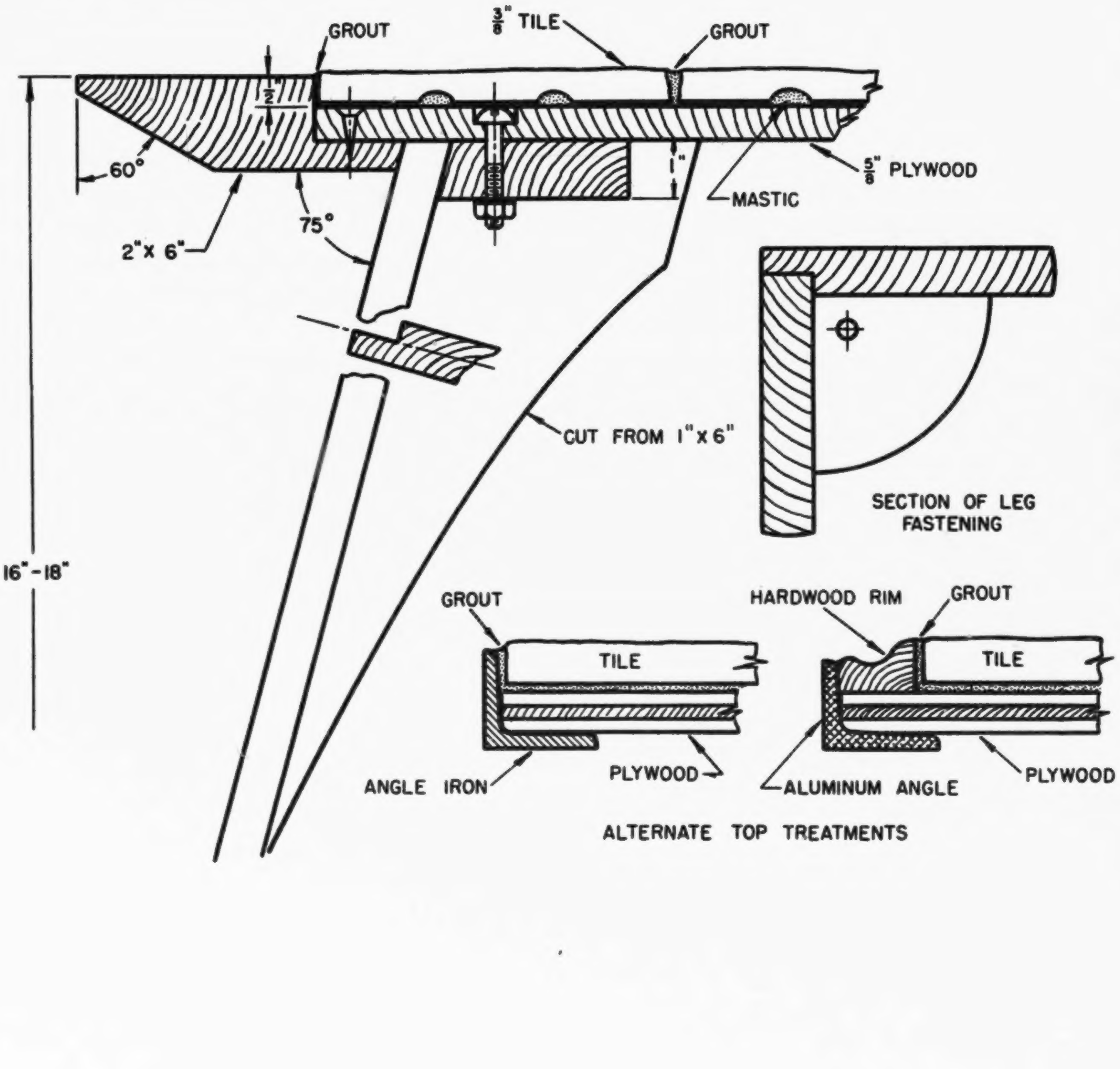
Hendrickson, E. A. *Mosaics: Hobby and Art.* pp. 10-11

TILE TOP TABLE

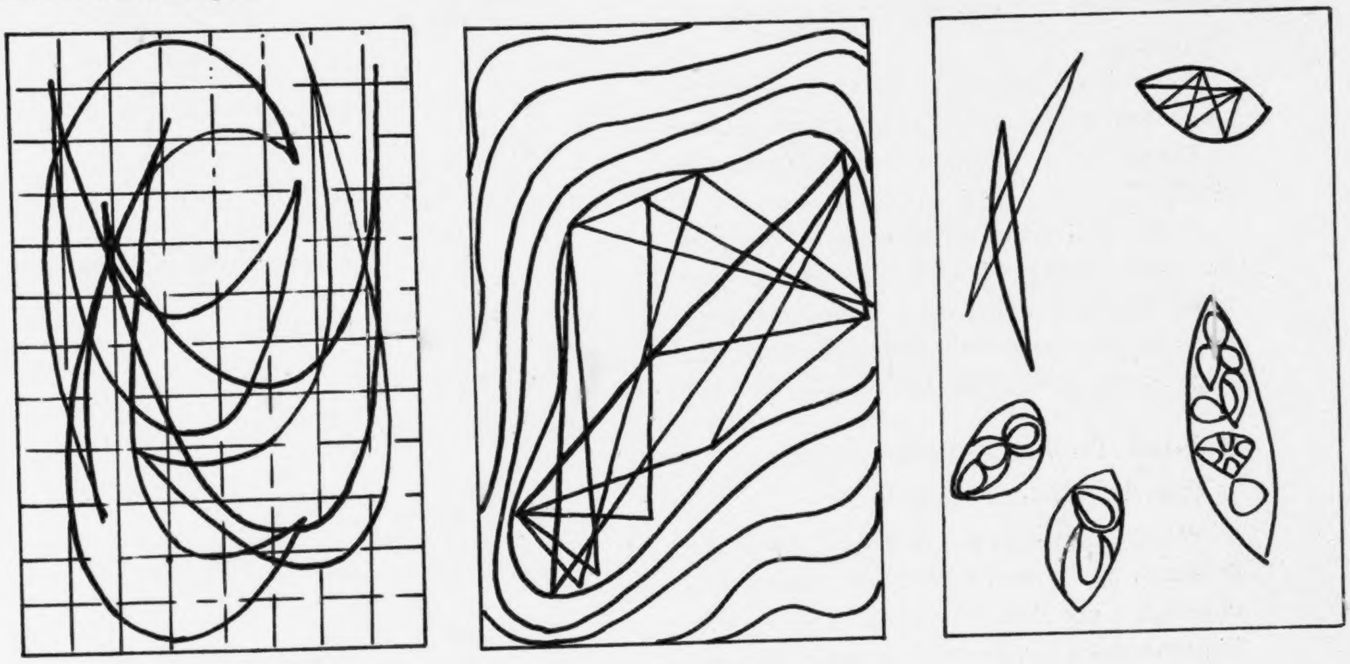
A tile top coffee table makes a fine combination wood and ceramic project. Designing and making tiles which blend with the decorative scheme of the home will make this table distinctive.



Working Drawing


GROUT
3/8" TILE
GROUT
1/2"
60°
2"x 6"
75°
1"
5/8" PLYWOOD
MASTIC
CUT FROM 1"x 6"
SECTION OF LEG FASTENING
16"-18"
GROUT
TILE
ANGLE IRON
PLYWOOD
HARDWOOD RIM
GROUT
TILE
ALUMINUM ANGLE
PLYWOOD
ALTERNATE TOP TREATMENTS

Alternate Designs



Research Activities

Make test firings of glazes to match the home furnishings.

Experiment with designs of a contemporary or traditional character to match other furnishings.

Study samples of various types of glazes to determine the one most suitable for a table top.

Procedure

Make tiles before frame for top is constructed. (Tiles will shrink, may be distorted or knocked out of square, etc. Wood or metal is more flexible than fired clay.)

Plan the size and number of tiles that will be required.

Prepare an open body similar to a sculpture body to minimize distortion. (Run tests for shrinkage, glaze, and engobe fits, etc.)

Have the total finished project planned so that engobe and texture applications as well as glaze treatments are all understood and will work with the tile divisions.

Roll out tiles to required size and thickness. (See figure 1.)

(Tiles can also be cut from a lump of clay using a thin cutting wire along similar gauge sticks.) (See figure 2.)

It is suggested here that two pieces of Masonite or its equivalent be cut the size of each tile. By making a sandwich of this the handling of tiles will be facilitated and distortion will be lessened. (See figure 3.)

Cut tiles following edges of Masonite template.

Allow tiles to become leather hard. Turn tiles over several times so that they

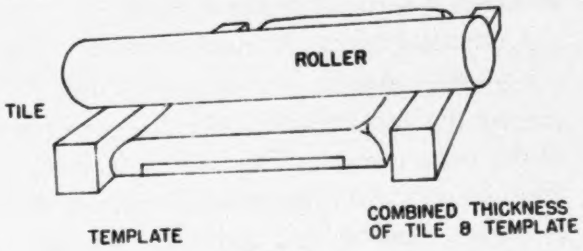


FIGURE 1.

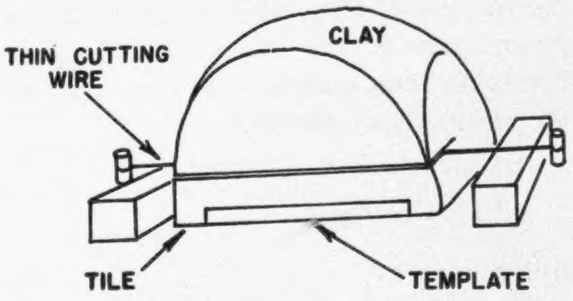


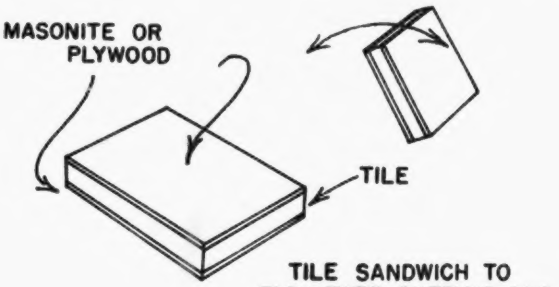
FIGURE 2.

will dry flat. Perform all decorative treatments, such as engobe or texturing, at this time.

After final firing arrange tiles in proper order and measure for frame construction.

Grout into position when frame is ready.

Note: If desired, small mosaic tiles may be made using an extrusion press (see unit, Extrusion Press). A special edge tile can also be extruded for finishing the edge of the table. (See figure 4.)



TILE SANDWICH TO FACILITATE CUTTING AND MOVING

FIGURE 3.

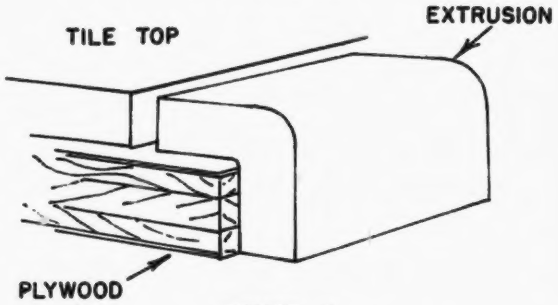


FIGURE 4

Related Technical Information

Carving Leather-Hard Clay:

When clay is in the leather-hard stage, it seems to be best suited for cutting and carving. Clay that is plastic is too yielding and has a tendency to assume a meaningless slump-like quality if any amount of cutting or carving is attempted. On the other hand when clay is bone dry a very harsh, gritty quality occurs quite naturally and forming problems are increased. Only during the leather-hard stages does clay respond willingly to cutting and carving. Industries that fashion huge electric insulators for power lines perform their turning operations during the leather hard stage. All sculptoring operations are most successful when done during this stage.

Another topic to explore:

Mechanical and Chemical Water in Clay

Demonstrations

Carve and cut clay when leather hard.
Set tiles.
Stack tiles for firing.

Related Cultural Information

Ceramic Objects Record Culture:

Ceramic objects are seemingly full of contradictions. At one extreme they are among the most fragile objects ever created by man and at the other extreme one of the most durable. The only remaining trace of many bygone cultures that record their history are objects of a ceramic nature. A single pot or even part of a single pot when studied by a trained archaeologist reveals an amazing amount of information. Objects that were made of wood or metal have long since been consumed by the ravages of time, while ceramic objects continue to remain seemingly untouched by comparison. The clay tablets of the Babylonians, many of which are in perfect condition even after several thousand years, remain as an outstanding example of the durability of ceramics.

Another topic to explore:

Egyptian Paste

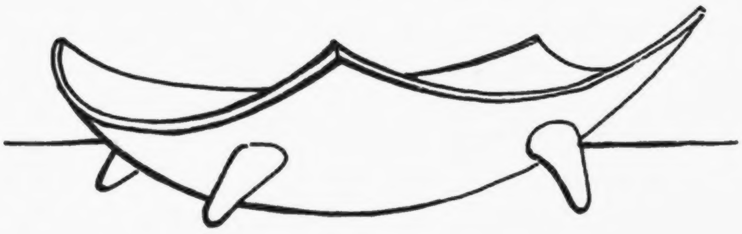
References

Stiles, H. E. *Pottery of the Ancients.* pp. 36-39
World Book Encyclopedia. p. 365

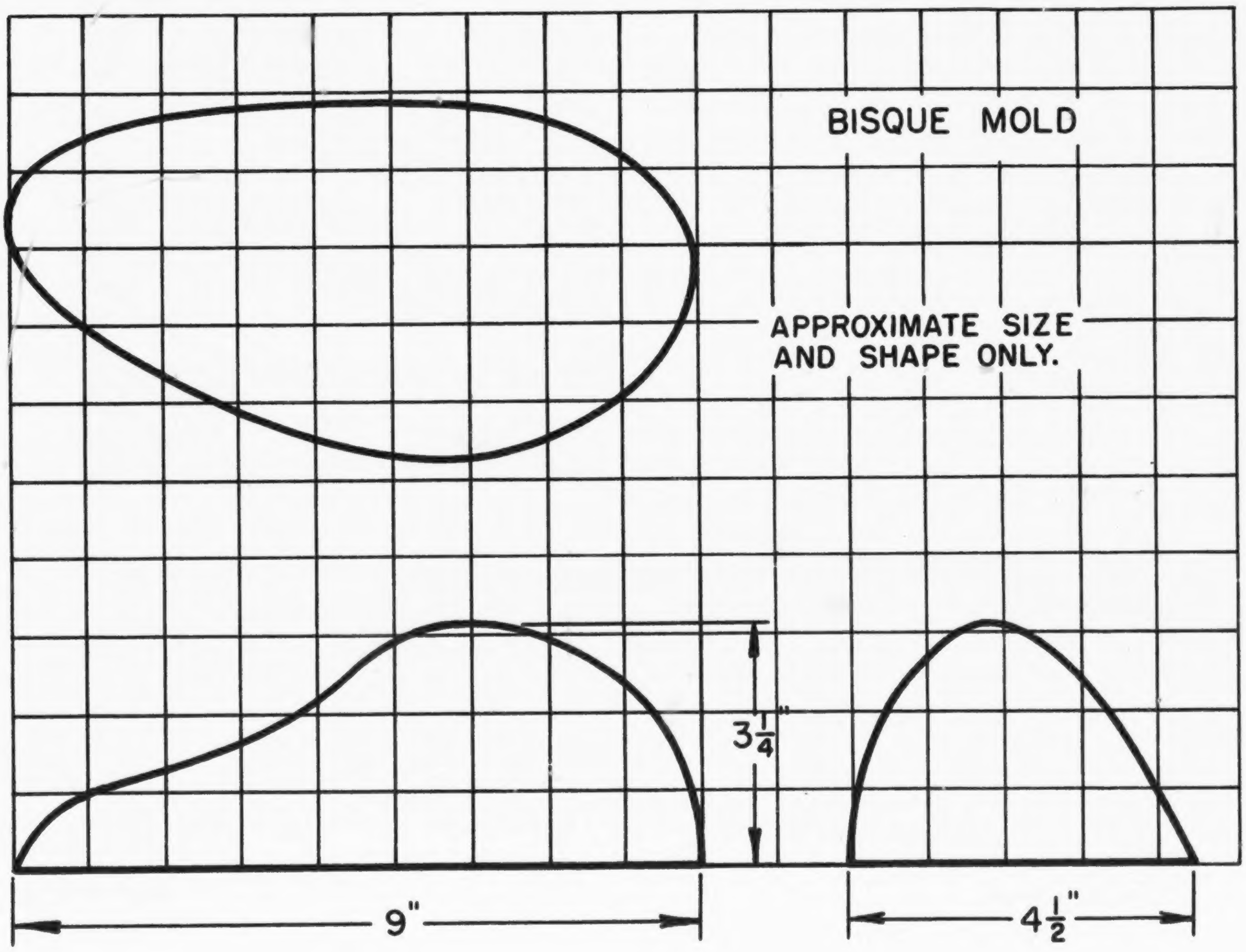
FREE FORMING

FREE FORM BOWLS

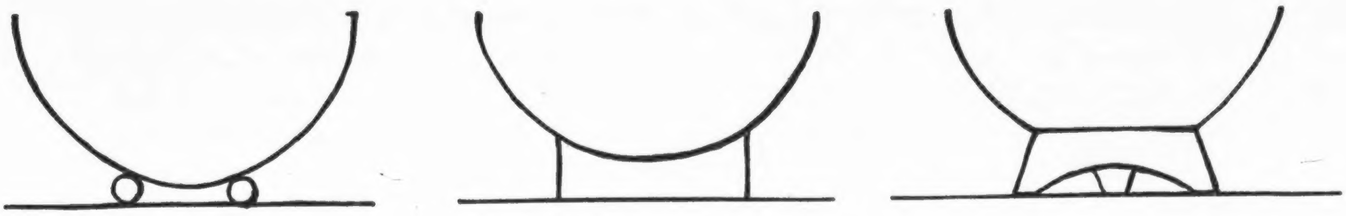
Open trays and bowls of various shapes and sizes have a useful place in any home. The beginner can be assured of success using a simple hump mold.



Working Drawing


BISQUE MOLD
APPROXIMATE SIZE
AND SHAPE ONLY.
3¼"
9"
4½"

Alternate Designs



ALTERNATE FOOT TREATMENT

Research Activities

Sketch various shapes for a hump mold with newsprint and a crayon. Work at full scale until an acceptable shape is derived.

Look for stones that could serve as molds.

Experiment with various materials and tools to produce a texture on the surface of the finished project. Materials such as burlap, dishcloths, string, etc., pressed into the soft clay, when used with discretion, can produce interesting results.

Carve directly on the hump for textural effects. This should be done with caution because the carving will, of course, remain on the mold.

Procedure

Roll out a slab of clay to the thickness and size required.

Place slab on selected portion of mold. (See figure 1.)

Press out any folds or wrinkles.

Trim to size.

Texture outside surface if desired.

Make provisions for a foot treatment.

Remove piece when dry enough to support itself.

Fettle and finish as desired.

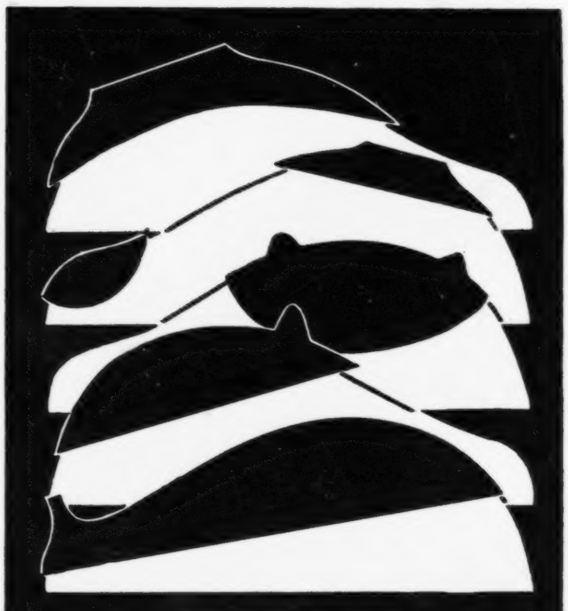


FIGURE I.

Related Technical Information

Finishing the Surface of Plaster:

There are various acceptable ways of finishing a rough piece of plaster if it is to be used as a hump mold. Wet or dry sandpaper, grit cloth, sponge rubber scouring pads (rubber scrubber) all work fairly well. Be sure to clean and dry all metal hand tools after they are used.

Other topics to explore:

Causes of Heat Generated While Plaster Is in the Process of Settling
Effect of Too Much Heat Applied When Drying a Mold

Demonstrations

Mix plaster.

Utilize plaster's period of plasticity.

Related Cultural Information

Use of Hump Molds:

Forming over a hump is probably one of the oldest methods of handling clay. The ease with which well-made work is accomplished undoubtedly encouraged this method of production among cultures of a primitive nature. Chinese potters according to Leach used bisque clay for their hump molds. Many Sung (960-1279 A.D.) bowls were made by pressing and beating the outside of thrown shapes onto engraved convex molds. Up to the present day, the Chinese use biscuit molds very ingeniously. Hump molds are still used today by molding potters who have limited production runs on certain pieces of ware.

Another topic to explore:

Techniques of Shaping Clay Developed By Primitive Cultures

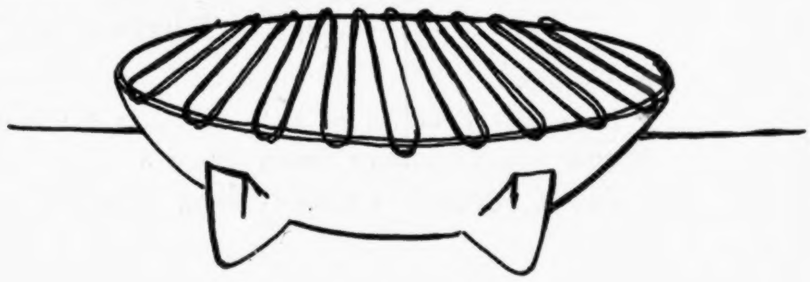
References

Industrial Division of U.S. Gypsum Company. *How To Make Patterns and Models with Gypsum Cement.* pp. 5-8

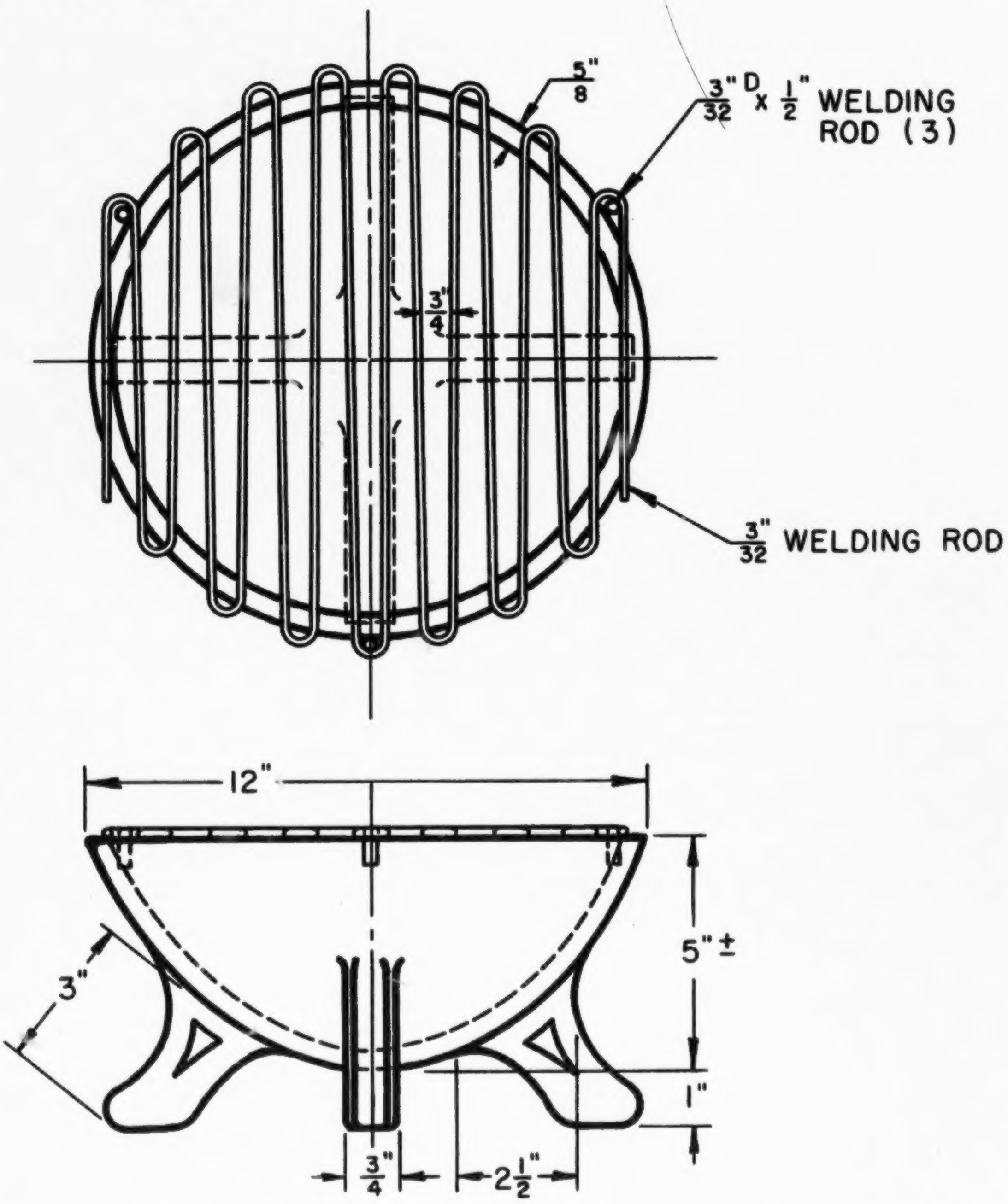
Leach, Bernard. *A Potter's Book.* p. 95

CHARCOAL BRAZIER

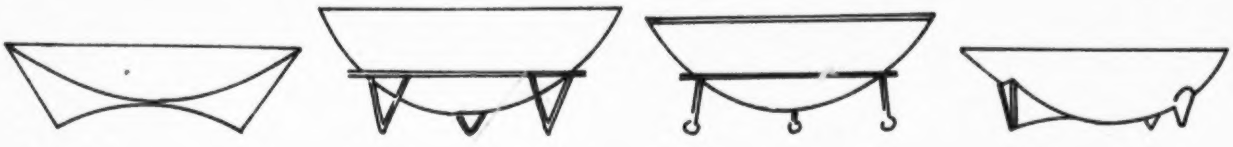
A charcoal brazier makes tabletop cooking possible on porch, patio, or yard. This interesting and useful project takes advantage of clay's unique qualities of durability and heat resistance.



Working Drawing


5"/8
3"/32 D x 1/2" WELDING ROD (3)
3"/4
3"/32 WELDING ROD
12"
5" ±
3"
1"
3"/4
2 1/2"

Alternate Designs



Research Activities

Experiment with trial designs by "sketching in clay," that is, modeling small shapes with the fingers using the pinch or slab method or a combination of these.

Try other footing such as a tripod, ring, or metal frame.

Test various clay and grog mixtures for resistance to heat shock.

Try adding a material such as sawdust which will burn out and increase the insulating quality of the ware.

Practice with a heavily grogged body on the potter's wheel, noting how well it resists sag and slump.

Procedure

Improvise an inverted shape or hump of the desired proportions. (Use plaster, clay, the bottom of a basin or bowl, or a combination of these.)

Wedge grog (40-60 mesh) into soft plastic clay, using approximately ⅓ grog, ⅔ clay, or use prepared terra cotta body.

Pound and roll out a slab of proper size on cloth, a thickness of between ½ to ¾ inch.

Pick up slab on cloth, invert over hump, mold and smooth to contour of model.

Trim outside edge to shape.

Model and weld on legs or foot, refine surface, and allow piece to stiffen. Help piece to free itself from mold occasionally.

Remove from hump, refine outside edge, and repair defects on interior surface where needed.

When bone dry fire to a *soft* bisque (approximately 1,650° F for cone 04 clays).

Related Technical Information

Grog:

Grog is clay which has been fired and then ground into granular form. It may be purchased in many forms such as fire clay grog, usually a buff color, or porcelain grog, which is white. Grog can be made by grinding any fired clay such as bisque pottery or red brick and screening it for size. A grog that will pass the 20 mesh screen is considered coarse, while the grog which passes a 40 mesh screen is referred to as medium size.

Local materials such as ground shale, sand, and silty clays can often be utilized effectively as grogs and produce interesting results.

The use of grog or other nonplastic additives to a clay body will usually result in decreases in drying time, shrinkage, and warpage, and less tendency for body to sag during construction. It also permits the use of thicker sections and a fairly rapid firing rate as the grogged body has little trouble giving up water.

Many interesting surface textures can be created by the use of different materials for grog and by the effects of various tools and techniques in finishing off the surface.

Other topics to explore:

The Effect of the Addition of Organic Material Such as Sawdust to Clay Body

The Effect of the Addition of Granular Metallic Oxides Such as Manganese or Illmenite to Clay Body

Demonstrations

Wedge grog into clay.
Roll slabs.
Form ware over hump mold.
Weld clay.
Stack and fire kiln.

Related Cultural Information

Refractories:

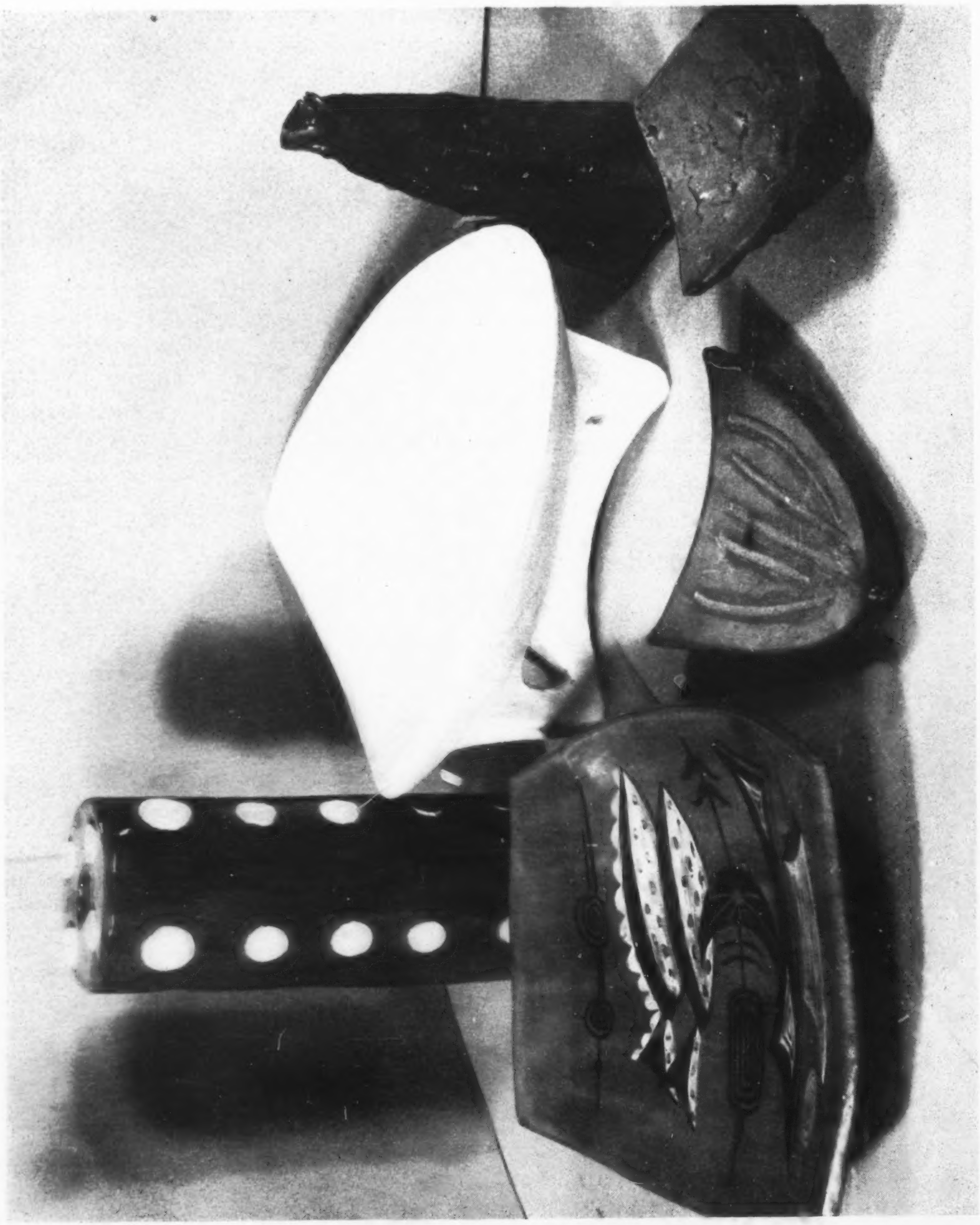
Since man first tamed fire and made it his servant, he has turned to earthy materials—clays in particular—to contain and direct its heat. Clay products whose prime purpose is to resist the effects of fire and heated materials are called refractories. The refractories branch of the ceramics industry manufactures approximately $300 million worth of refractory products each year. While we use some refractory products in our homes, such as furnace linings and firebrick, most of the products are used by basic industry. Some of these are: the smelters and refiners of metals, whose huge furnaces are lined with special refractories, and other ceramic industries such as glass, cement, and abrasives whose huge tanks and kilns are wholly constructed of refractory shapes. The producers of electric power also depend upon refractory products to confine and direct the heat produced efficiently, whether it be from coal, oil, gas, or atomic reaction.

Other topics to explore:

Other Uses of Clays in Basic Industry
How Refractories Are Made

Reference

Norton, F. H. *Ceramics for the Artist Potters.* pp. 18-20

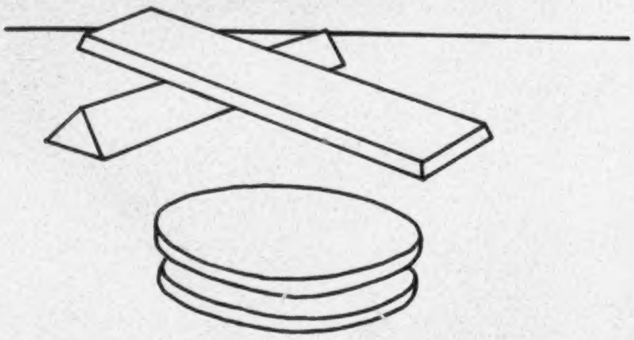


A brazier and other pieces constructed from slabs.

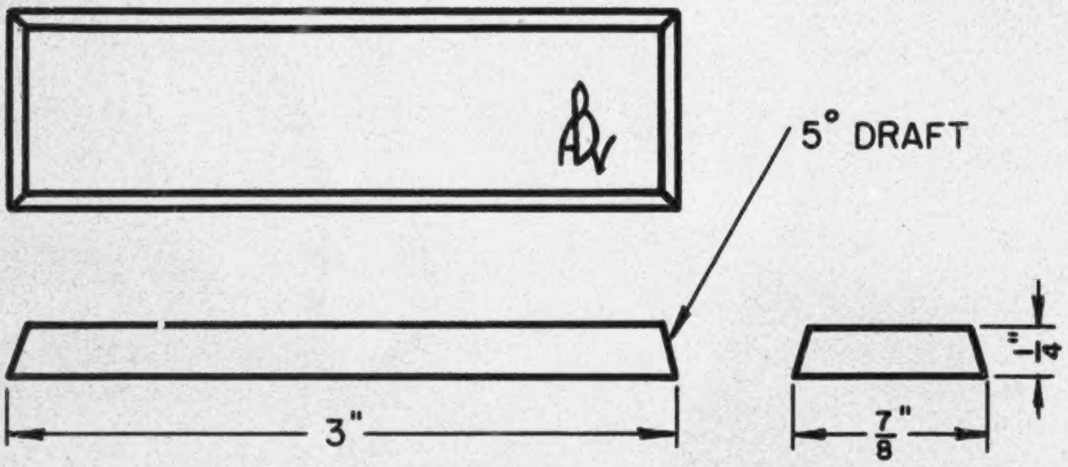
PRESS MOLDING

SHARPENING STONES

A pocket sharpening stone is an interesting and useful project that can be made in a few periods. Other shapes for special sharpening jobs can easily be formed and quickly fired in a test kiln.

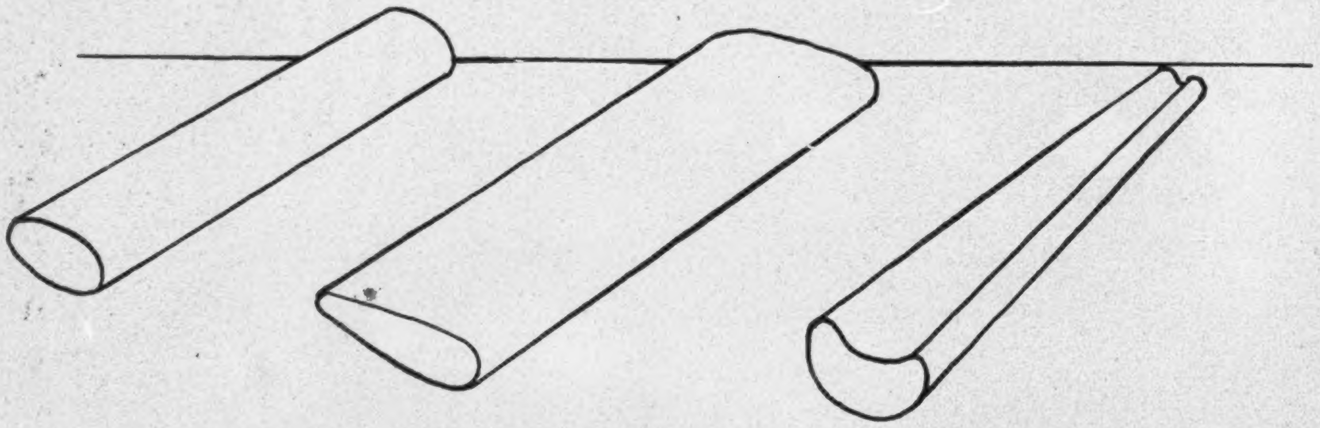


Working Drawing



POCKET STONE

Alternate Designs



Research Activities

Design small abrasive shapes for special purposes such as sharpening slips for carving tools, gouges, auger bits, camp axes, and fish hooks.

Try several sizes of abrasive grain in different proportions in different clay bodies.

Experiment with solid casting as a method of producing accurate reproduction of a certain shape in quantities.

Experiment with forming a two-faced stone using a different abrasive grit size for each side.

Procedure

Note: This project may be formed by pressing, slab forming, or casting.

Make a model of the shape desired using either clay or plaster. (Be sure to provide draft.)

Cast a mold over the model, remove model and allow mold to dry.

Weigh out 150 grams (enough for two pocket stones) of a plastic modeling clay.

Weigh out approximately one-third of this or 50 grams of abrasive grain (100-120 silicon carbide or aluminum oxide).

Wedge the grain thoroughly into the body, adjusting plasticity with water if necessary.

Smooth surfaces and refine corners when piece is dry.

Fire piece to proper cone appropriate to the body clay being used.

Related Technical Information

Abrasive Stones:

Abrasive stones are made principally of silicon carbide (SiC) or aluminum oxide ($A1_20_3$) grains bonded together. This bond is usually ceramic such as clay or glass. Recently for special uses other bonds, notably rubber, shellac, and other organic resins, have been used extensively.

The size of the abrasive grain and the type of bond are most important factors in the final use of the abrasive product. In the project suggested here, for example, the use of a coarse abrasive grain and a soft porous clay body will result in a fast cutting stone, the surface of which will wear rapidly and expose new, sharp particles of abrasive grain.

The use of fine abrasive grain and the "tightening" of the body by the addition of glass formers or fluxes such as a body frit will produce a fine, dense, slow-cutting stone similar to a razor hone for the final whetting of cutting tools.

Another topics to explore:

How Abrasive Grains Are Made

Demonstrations

Weigh ceramic material.

Wedge clay.

Make a plaster model.

Press clay into a plaster mold.

Finish greenware.

Related Cultural Information

A Short History of Abrasives:

The use of abrasives for shaping and smoothing undoubtedly began with prehistoric man's first efforts to shape and sharpen tools and weapons by rubbing them against natural stones such as sandstone. In biblical times emery was used for sharpening, and in the 13th century records show that the Chinese used crushed seashells attached to parchment, thereby marking the first use of sandpaper as we think of it today. About 1700 the Swiss coated paper with crushed glass, (possibly the first artificial abrasive). This was replaced in 1800 by the use of flint quartz which is still in wide use today.

Grindstones made from natural sandstone were the first grinding wheels used in industry and were succeeded by the emery wheel which was invented about 1864.

In 1891 the first real breakthrough in man's search for a hard, cheap abrasive occurred. E. J. Acheson developed silicon carbide while trying to make artificial diamonds. Silicon carbide, next in hardness to the diamond, was followed by the softer but tougher aluminum oxide and these are still the key abrasives in industry.

However, the search has continued and in the middle 1950's scientists developed "borazon" with hardness close or equal to the diamond. Finally, in 1957, the creation of the first man-made diamond was announced.

Other topics to explore:

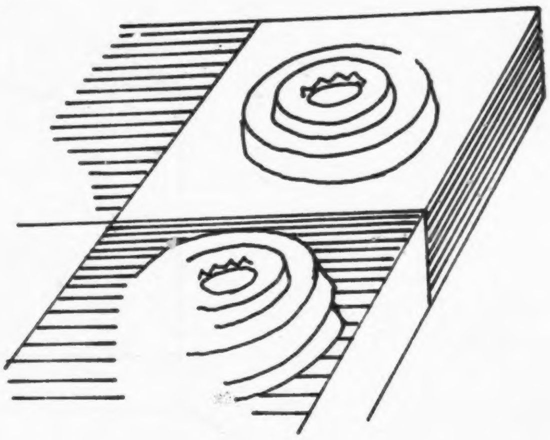
- Borazon
- Artificial Diamonds

References

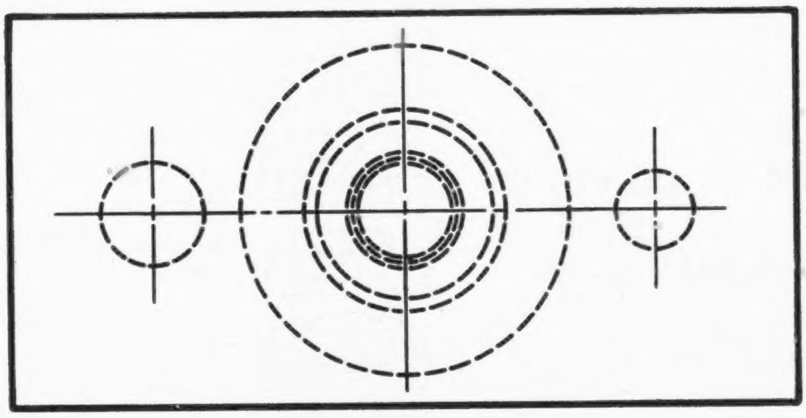
Fryklund, V. C. and Sechrest, C. H. *Materials of Construction.* pp. 199-209
Norton, F. H. *Elements of Ceramics.* p. 127

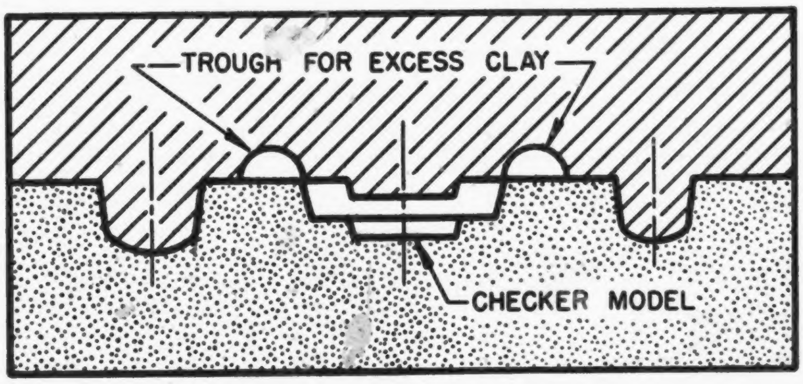
CHECKERS

A colorful set of ceramic checkers to be used on a wood or tile checkerboard in the gameroom at home can be a most interesting and valuable project. They can best be made using a two-piece press mold which will shape all surfaces of the piece.



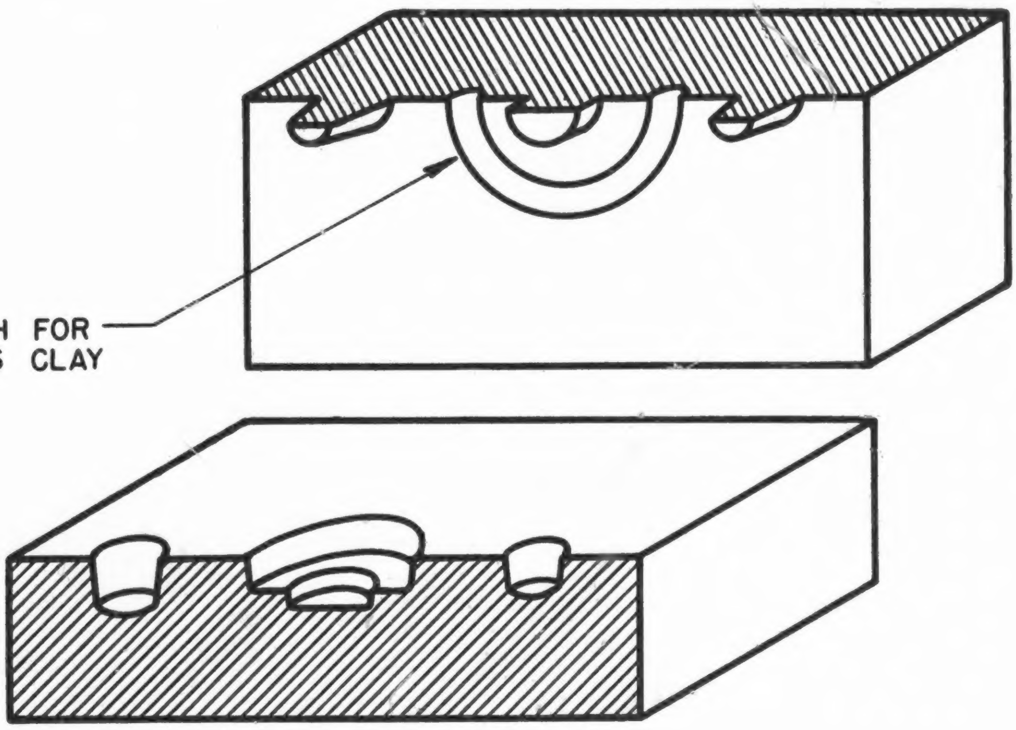
Working Drawing

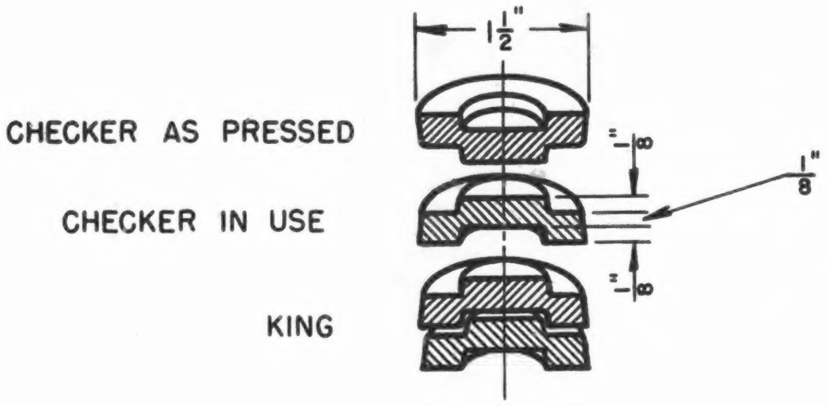



TROUGH FOR EXCESS CLAY
CHECKER MODEL

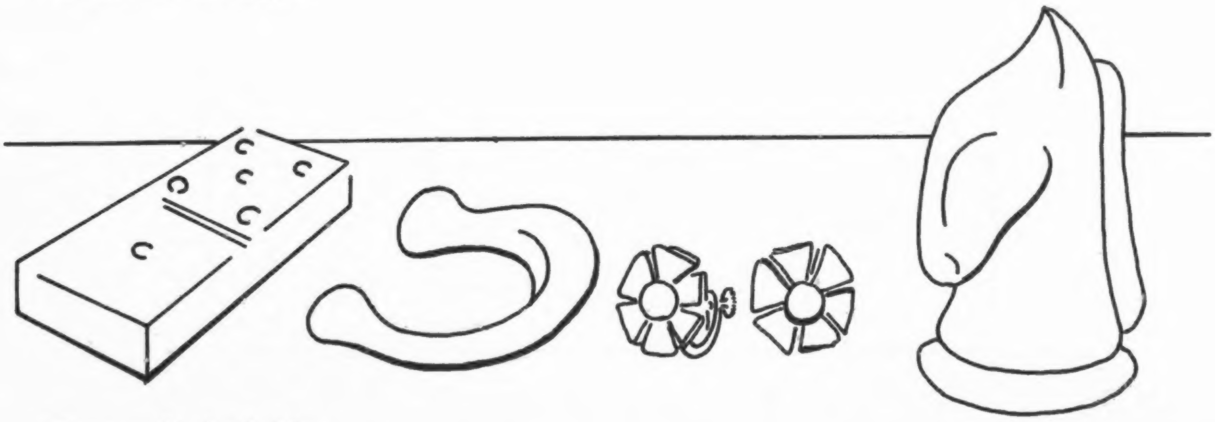
FULL SECTION

Open Mold


TROUGH FOR
EXCESS CLAY


1½"
CHECKER AS PRESSED
⅛"
CHECKER IN USE
⅛"
⅛"
KING

Alternate Designs



Research Activities

Design a cup handle for press mold forming.
Design a knob or drawer pull.
Search for button designs which could be made by pressing.
Conventionalize chess figures to permit pressing.
Design jewelry for pressing such as earrings, brooch, pendant, or cuff links.

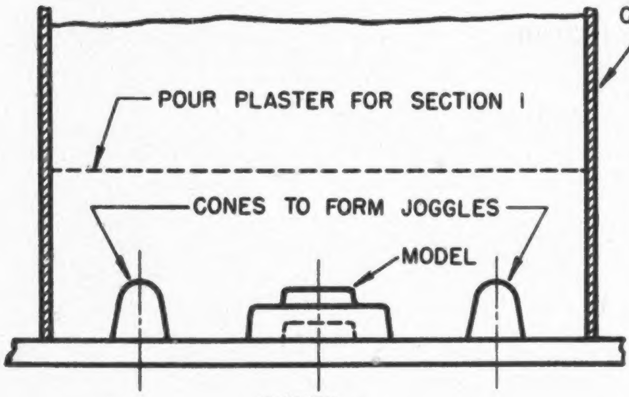


FIGURE I.

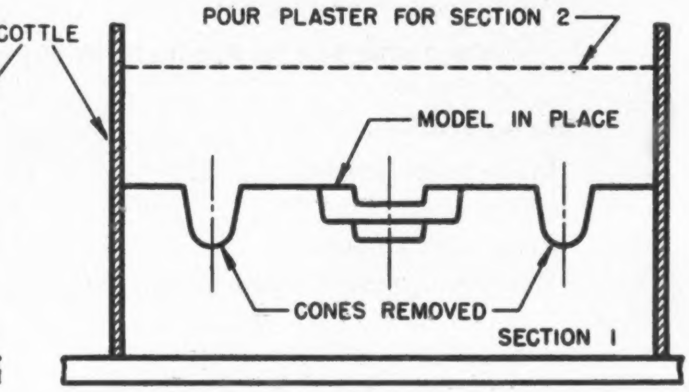


FIGURE 2.

Procedure

Design checker-crown to fit into recess under checker for "kings."

Make model of clay, plaster, wax, or wood. Size, if necessary.

Make guide joggles in the shape of blunted cones.

Arrange model and joggles on surface suitable for plaster casting. (See figure 1.)

Set up cottle, mix and pour plaster for first section of mold.

Invert plaster mold section, remove joggles, clean and size plaster leaving model in position. (See figure 2.)

Set up cottle, mix and pour plaster for second section of mold.

Carve trough around entire outline of model in second mold section to receive any excess clay. Allow mold to dry thoroughly. (See *The Complete Book of Pottery Making,* p. 121.)

Place a ball of clay in first mold section (proper size of ball will be determined by trial), place second section in position and press halves together firmly.

Open mold, remove press piece and waste clay.

Repeat pressing for required number of pieces.

Fettle, sponge, and dry pieces.

Bisque fire pieces.

Apply glaze, use contrasting colors for each half of checker set.

Glaze fire glazed piece.

Related Technical Information

Preparation of Clay for Hand Pressing:

Clay for hand-pressed ware must be fairly plastic and free from gritty materials such as grog and sand. Its consistency must be such that the water content of the clay will be as low as possible and still yield sharply detailed ware which releases quickly and easily. Soft clay which contains a higher percentage of water causes the clay to tear easily upon removal, resulting in loss of detail. Such clay would also tend to release very slowly and wet the mold excessively so that it would have to be dried before it could be used again.

Pressing of ceramic shapes in industry is accomplished in two ways. Dry pressing is done with slightly damp powdered clay bodies in metal molds and dies. This method yields a very dense ware and is generally used for electrical porcelain. Ram pressing is a more recent development which employs a plastic clay body and hard porous plaster molds. Hydraulic pressure presses the plastic clay to shape and air pressure is introduced through the mold ejecting the pressed ware. In some ram presses vacuum pressure is utilized to draw off water while the clay is being pressed. This latest industrial pressing method can produce fairly large solid objects.

Another topic to explore:

Commercial Articles Produced by Ram Pressing

Demonstrations

Make guide joggles.
Carve plaster.
Press a clay figure.
Remove a pressed figure from mold.

Related Cultural Information

Importance of Forming by Pressing:

The cultural characteristics of our society have been defined as resulting from our industrial and technological achievements. A careful analysis of manufacturing methods will show that the basic principle of pressing as applied to almost any material can be singled out as the one process to be credited with the greatest influence on our industrial advancement.

In ceramics, clay is pressed by fingers, pressed into molds by hand or some mechanical contrivance, or pressed through dies. Glass when molten is pressed by air pressure or die into molds, or pressed between rollers to be shaped. Gypsum products and cement are pressed to be shaped and finished. In the malleable metals field, pressing of one form or other, either mold, die, or rollers, leads all other formative processes in the production of their numerous products. Even the wood industry uses pressing in the formation of plywoods, and pressed panels of all sorts. The relatively new field of plastics has borrowed the pressing techniques of the older industries and profitably applied them to their new synthetic materials.

It is awesome to consider that our numerous mass-produced commodities, our luxuries, our necessities, our very existence, has been so profoundly influenced by so simple an act as pressing a piece of clay to change its shape.

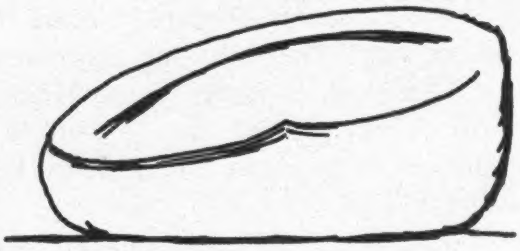
Reference

Kenny, J. B. *The Complete Book of Pottery Making.* p. 121

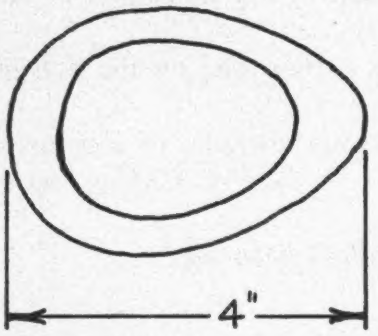
SOLID CASTING

ASH TRAYS

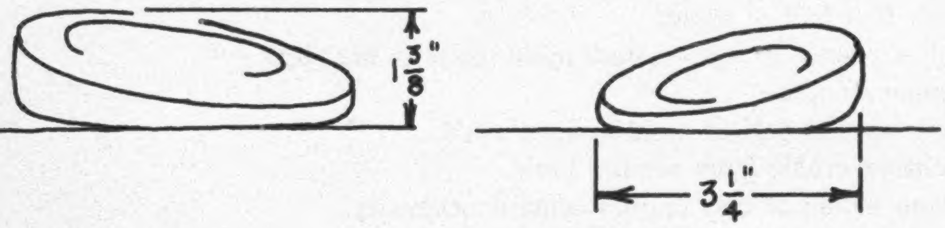
Very rugged and unique ash trays are fine gifts for the smoker or for general household use. The fact that this is a cast item makes it an excellent mass production problem for a group of students.



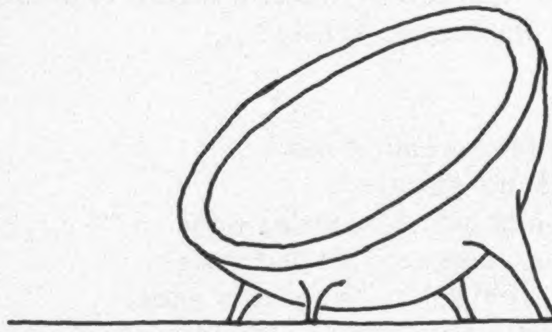
Working Drawing

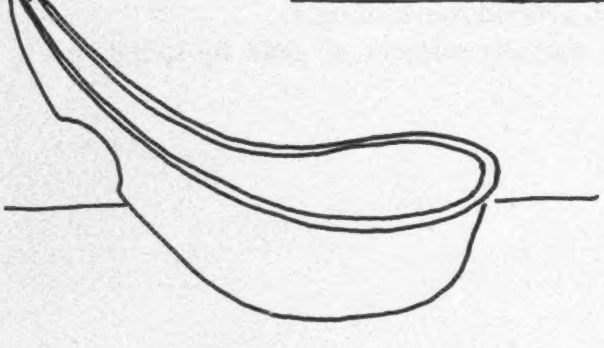


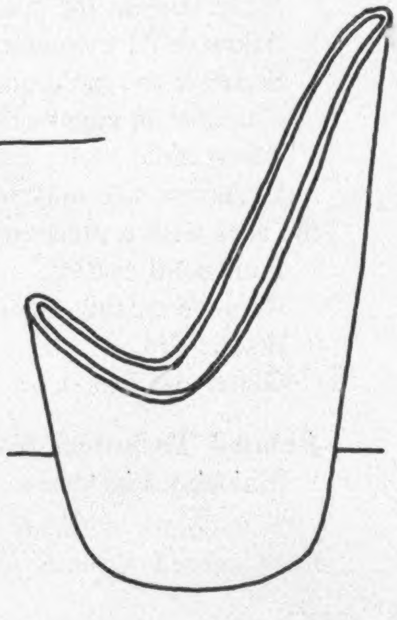
Try these dimensions as a point of departure. Carve the model to fit the hand, bearing in mind the danger of undercuts and the shrinkage allowance that must be considered when making a model.



Alternate Designs







Research Activities

Observe the smoking habits of various people in regard to making an ash tray to fit individual requirements.

Investigate ash tray solutions during certain periods of history.

Procedure

A solid cast model could be made from materials such as plastacine, wood, plaster, or clay. The following procedure is recommended if plaster is to be used.

Cast a block of plaster slightly larger than the finished model requires.

Block out general shape of model and carve with a knife. A kitchen paring knife or old jackknife works well. (Plaster carves better when it is saturated with water.)

Continue carving until model is completely roughed out.

Avoid undercuts on the inside profile.

Remove knife marks and soften edges with wet or dry sandpaper or an abrasive square of sponge rubber.

Study the finished model and sketch in the parting line on the outside profile. (An indelible pencil works well.)

Place model on a smooth surface and build up a cradle of clay or plastacine to the parting line. (See *The Complete Book of Pottery Making,* pp. 112-118, 140-141.)

Allow at least 1 inch all around model for finished mold size.

Using mold separator, size all surfaces.

Set up wooden cottle.

Pour first half of mold.

Allow plaster to harden until mold starts to heat up.

Remove cottle.

Pick up first half of mold and set aside.

Remove cradle from around mold.

Clean model of clay or plastacine if necessary.

Replace model in the first half of mold.

Make and establish spare from clay or plaster if needed to form a foot. (See *The Complete Book of Pottery Making*. pp. 116-117.)

Cut joggles.

Repeat sizing and cottle.

Establish and then pour second half of mold.

Make certain the spare is not disturbed.

Allow mold to generate heat before removing cottle.

Separate the mold and then remove spare and model.

Chamfer all edges of finished mold with a plaster plane.

Allow mold to dry completely before using. (Avoid overheating.)

Excessive size may be removed from the working surfaces of mold by sponging the area with a mild vinegar solution.

Pour solid casting.

Remove casting from mold and clean.

Bisque fire.

Glaze and fire.

Related Technical Information

Finishing Plaster:

To achieve a finish of professional quality on plaster models that have been hand carved requires sanding with an abrasive material. A tool that continues to give superior results in a remarkably short time is a grit-faced square of sponge rubber. The sponge easily adapts itself to any contour and is available in several grit sizes. The sponges wash out quite easily when they become loaded with plaster. Under normal conditions these useful tools will last for a considerable length of time. Several chains of grocery stores supply these items for scouring pots and pans.

Other topics to explore:

The Composition of Plastacine
Model Making on a Plaster Wheel

Demonstrations

Carve plaster by hand.
Locate a parting line on an irregular-shaped model.
Cradle a model in clay or plastacine.
Cut joggles.
Chamfer edges of finished mold.

Related Cultural Information

Josiah Wedgwood:

True success is not a matter of luck or accident. Josiah Wedgwood, in order to develop and refine a result, labored through over 10,000 experiments before the world-famous Wedgwood Jasper was considered successful. The outstanding triumph in Jasper was the copy of the "Barberini" or "Portland Vase" which is one of the best known pieces of ceramic ware in the world.

Other topics to explore:

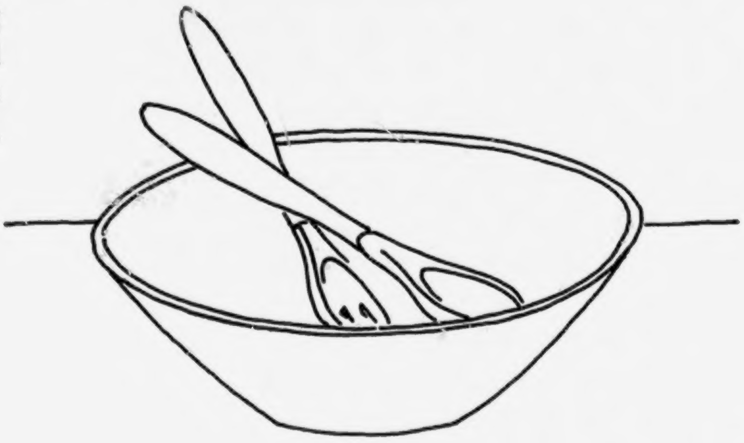
The Story of Wedgwood
The History of the Portland Vase

References

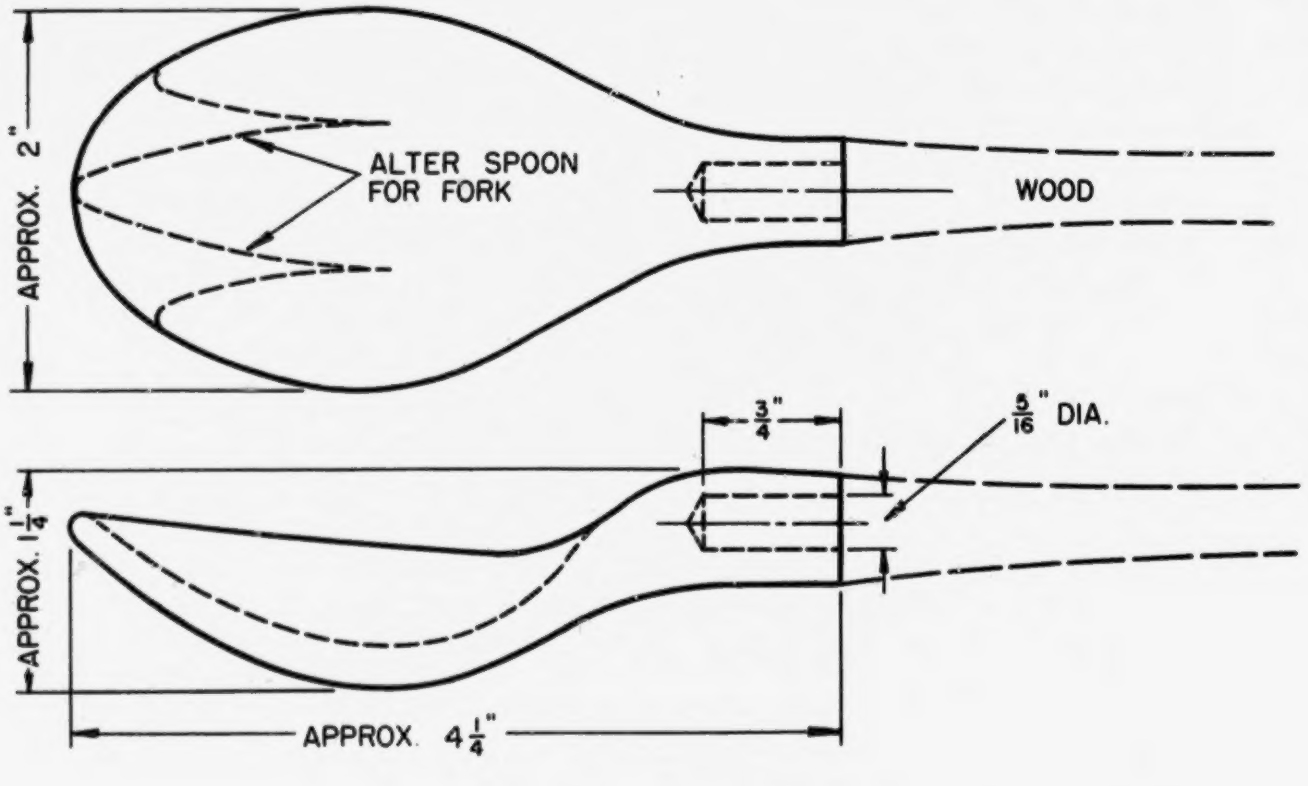
Kenny, J. B. *The Complete Book of Pottery Making*. pp. 112-120, pp. 140-141
Sanders, Herbert. *Sunset Ceramics Book*. pp. 89-91

SALAD SET

A neat and functional salad serving set can be accurately made and produced in quantity by solid casting. Other table pieces can be designed to add to this set.



Working Drawing



Research Activities

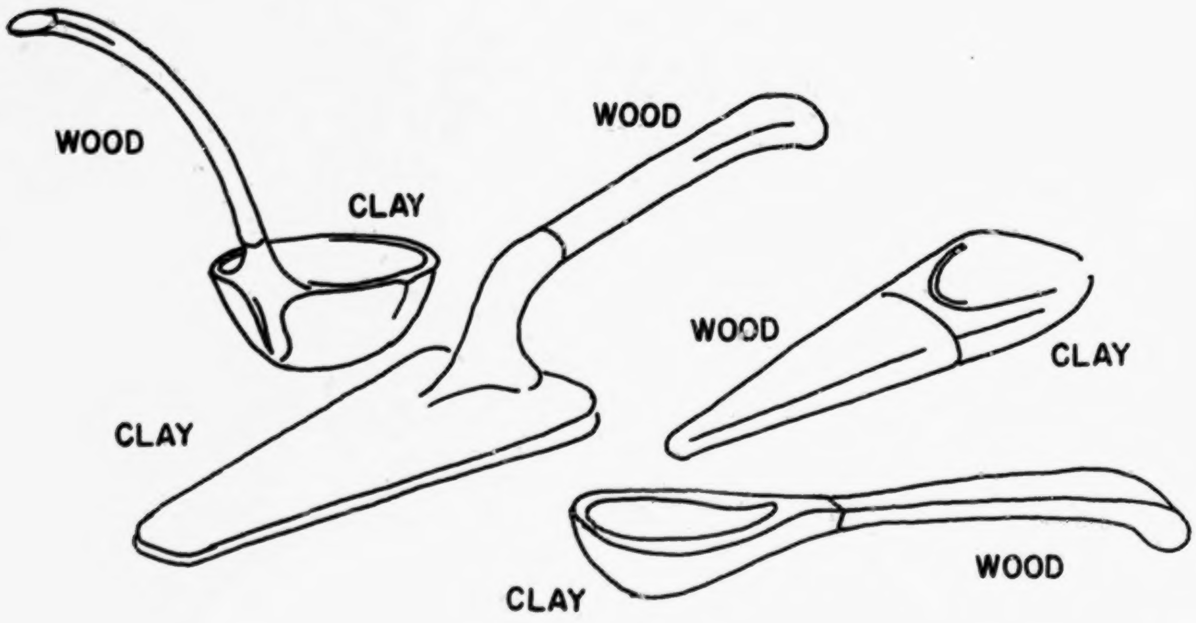
Design a solid cast shape that can be used as it is or altered by carving to serve another purpose (for example, a spoon shape that can be carved into a two- or three-tined fork).

Explore other possible ways of using the solid casting method to reproduce articles such as ash trays, jewelry, buttons, etc.

Investigate the types of cements and adhesives available for attaching handles and learn what special applications each has.

Make tests of the adhesives recommended for ceramic work and analyze the results.

Alternate Designs



Procedure

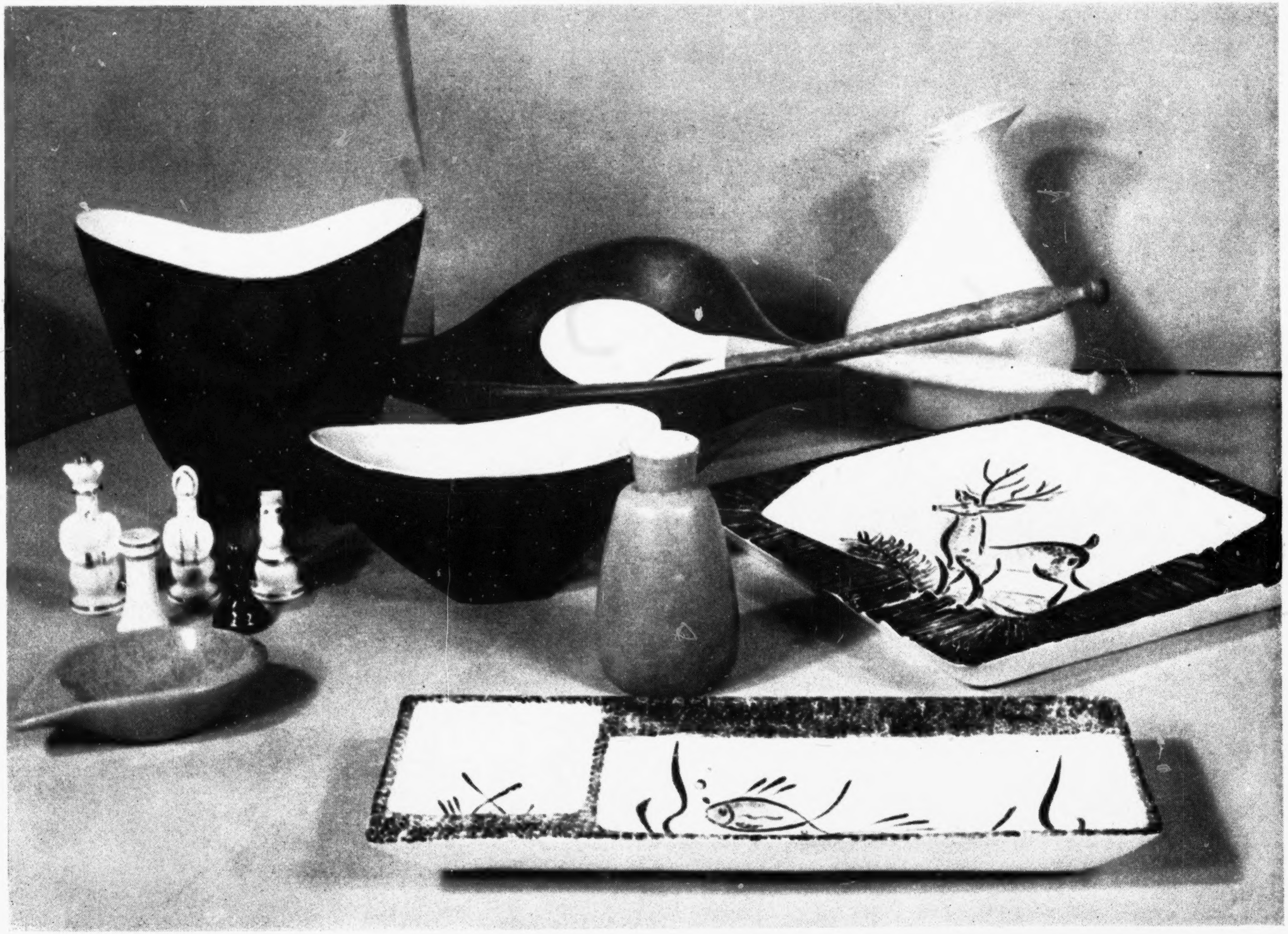
Design piece, draw full-size top and side views.
Transfer full-size drawings to plaster or wax block.
Cut top and side profiles.
Carve away excess material, smooth and refine shape. (See *Pottery,* pp. 79-80.)
Determine parting line on model and imbed model in clay.
Model clay spare on as an extension of handle.
Place cottle around work.
Mix and pour plaster.
Remove cottle and clay from beneath model; invert model on other half of spare.
Make notches and size first half of mold; pour plaster.
When plaster has set, clean up mold, allow to dry.
Cast shape, fettle and drill hole when dry.
Glaze and fire.
Turn handle, apply finish and cement in place.

Related Technical Information

Industrial Uses of Solid Casts:

Industry uses the solid casting method extensively to produce uniform clay shapes. In the production of pottery and chinaware, handles, knobs, and other solid parts are solid cast in gang molds. Manufacturers of refractories produce furnace and tank blocks up to 6 and 7 feet in length and 3 or 4 feet in cross section weighing up to 1,400 pounds in this manner. The slip used is specially compounded of refractory materials and relatively large particles of grog. The casting process requires days for the larger pieces and many weeks for drying. The pieces are fired in relatively small periodic kilns which require 2 or 3 days for a firing cycle. Upon cooling they are usually subjected to extensive grinding operations to bring them to precise dimensions.

A look at the various vitreous clay sanitary fixtures in use will reveal that most of them are produced by drain or solid casting or a combination of these methods.



Solid cast chessmen, trays, and salad set.

An increasing percentage of the smaller-sized pieces formerly requiring solid casting now are being produced by pressing at a lower labor cost. However, larger shapes continue to be made by solid casting.

Another topic to explore:

Ram Press Molding

Demonstrations

Carve a model from wax or plaster.
Make a two-piece mold with an irregular parting line.
Cast slip.
Fettle slip castings.
Load kiln.

Related Cultural Information

The Selection of Texture and Color in Glaze:

Much care and thought should precede the selection of texture and color of glazes, whether on commercial pottery being purchased or when making or choosing a glaze for application to one's own ware.

In the realm of colors lies an infinite variety of shades and hues. Choice should be made with consideration for personal taste, intended use, colors in immediate vicinity, and general color scheme of the room in which the piece will be used.

When texture is under consideration, remember that mat glazes are not generally suitable for interiors of food and drink containers, and that brilliant glossy glazes tend to overemphasize irregularity (such as in hand built pieces) and sometimes obscure delicate lines. Crackle or bubbly glazes, too, would tend to be poor choices for food containers or serving pieces.

Other topics to explore:

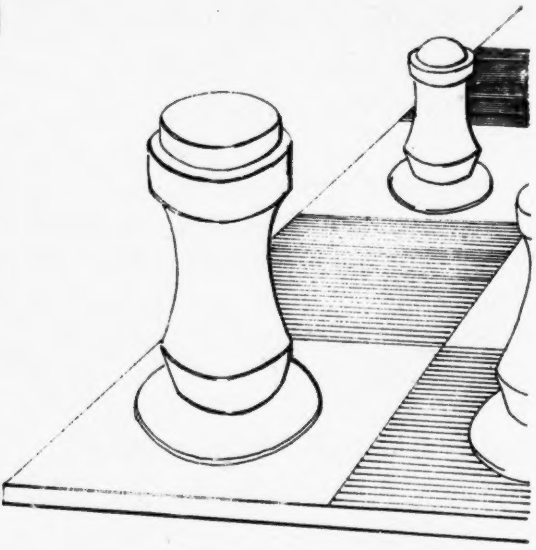
The Psychological Effect of Color on People
The Functional Design of Ceramic Pieces

References

Ansley, A. C. *Manufacturing Methods and Processes*. Chapter 20
Olson, D. W. *Pottery*. pp. 79-80

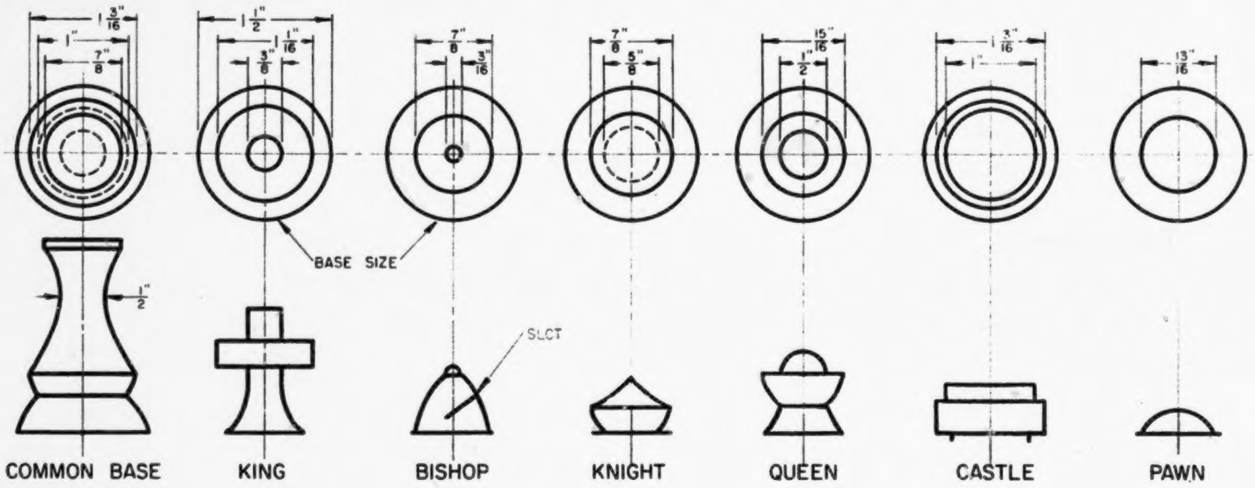
CHESSMEN

Making your own individually designed game pieces for a game set offers many possibilities in design and ceramic processes. Chessmen are among the most difficult game pieces to produce due to the variety of figures required. In the set shown the designs have been conventionalized so that the individual pieces could be reproduced from entirely turned models and solid cast in gang molds.

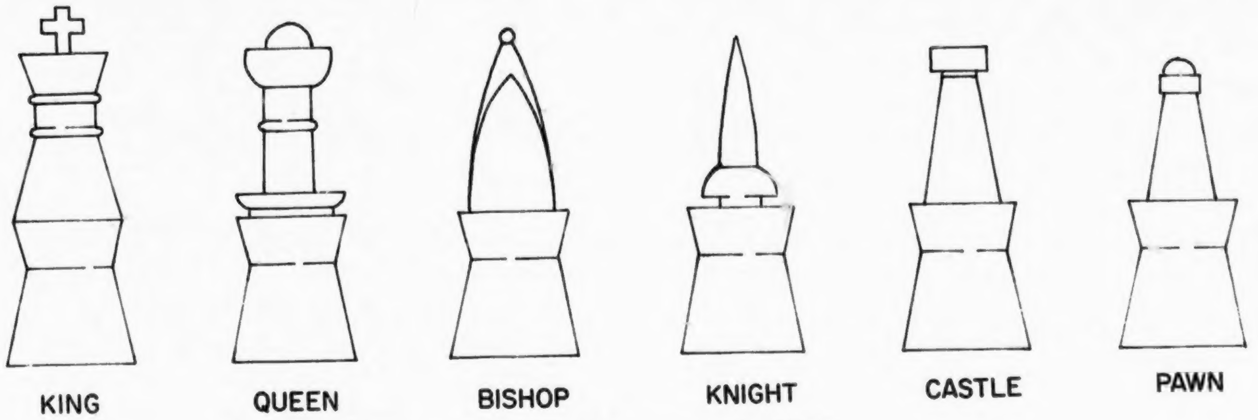


Working Drawing

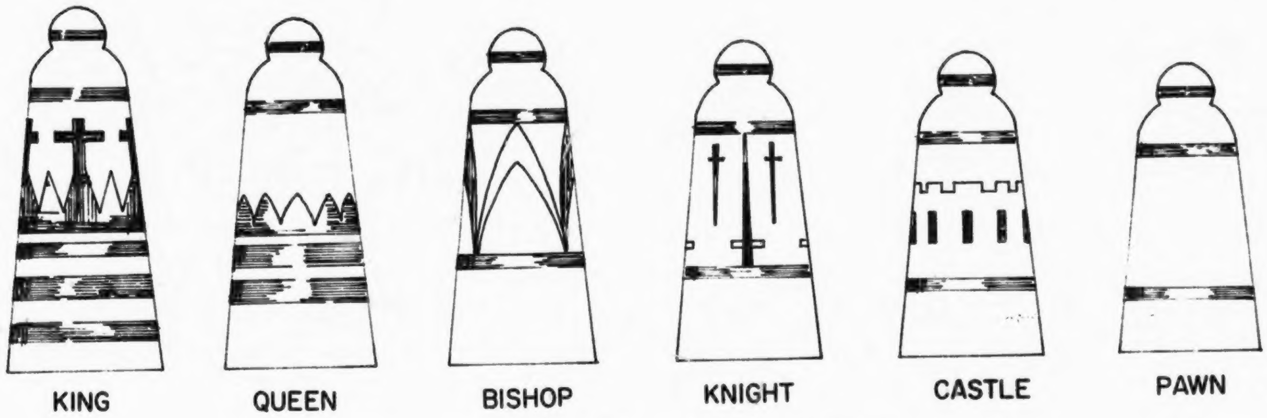
The drawings indicate one common base for all the pieces. Individual top pieces representing each of the chess figures are to be fastened to the bases to make up complete models.


1 3/16"
1"
7/8"
1 1/2"
1 1/16"
3/8"
7/8"
3/16"
7/8"
5/8"
15/16"
1/2"
1 3/16"
1"
13/16"
BASE SIZE
1/2"
SLCT
COMMON BASE
KING
BISHOP
KNIGHT
QUEEN
CASTLE
PAWN

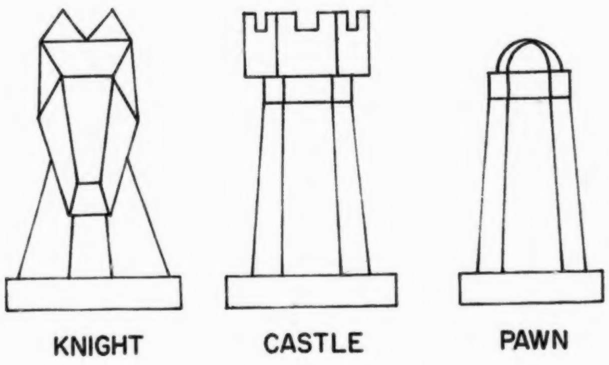
Alternate Designs


KING
QUEEN
BISHOP
KNIGHT
CASTLE
PAWN

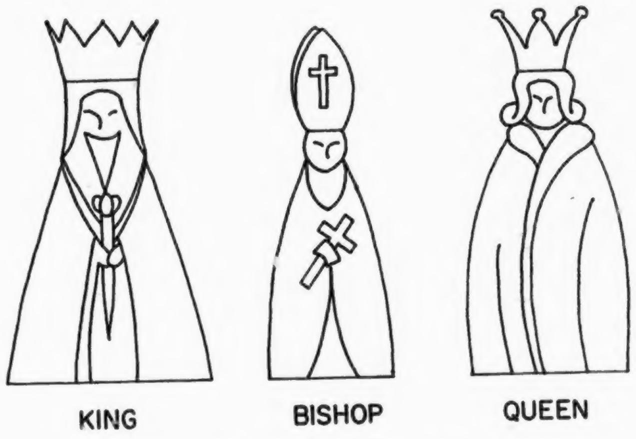
CHESSMEN TURNED – SYMBOLIC FORM ON COMMON BASE.


KING
QUEEN
BISHOP
KNIGHT
CASTLE
PAWN

CHESSMEN TURNED – SYMBOLS RENDERED ON SURFACE IN COLOR.


KNIGHT
CASTLE
PAWN

CHESSMEN CARVED FROM BLOCKS OF CLAY.


KING
BISHOP
QUEEN

CHESSMEN MODELED FROM CLAY

Research Activities

Redesign the chessmen combining wood, metal, and ceramics.
Design and construct a chessboard.
Construct press molds to produce chessmen.
Look up the history of chess and the rules of the game.

Procedure

Make templates of designs for common base and conventionalized top figure.

Following template design, turn plaster models required.

Note: Hard pattern wax may also be used as a material for turning the models.

Horizontal turning of small models can be best accomplished by placing cast slugs of hard, wet plaster or pattern wax in the jaws of a universal chuck.

Vertical turning of either wax or plaster can be done on the head of a potter's wheel. The material in this case is cast directly on the head of the machine.

Inverted vertical turning can also be done by holding the material in the chuck of a drill press.

Make two-piece block mold of base model.

Using plaster or pattern wax, cast eight duplicate bases from block mold.

Join the top figures to bases. Plaster pieces may be joined by wetting them and using a thin plaster slurry. Burned shellac may also be used. Low heat will join wax model sections.

Arrange completed models on clay beds for casting gang molds. (See figure 1.)

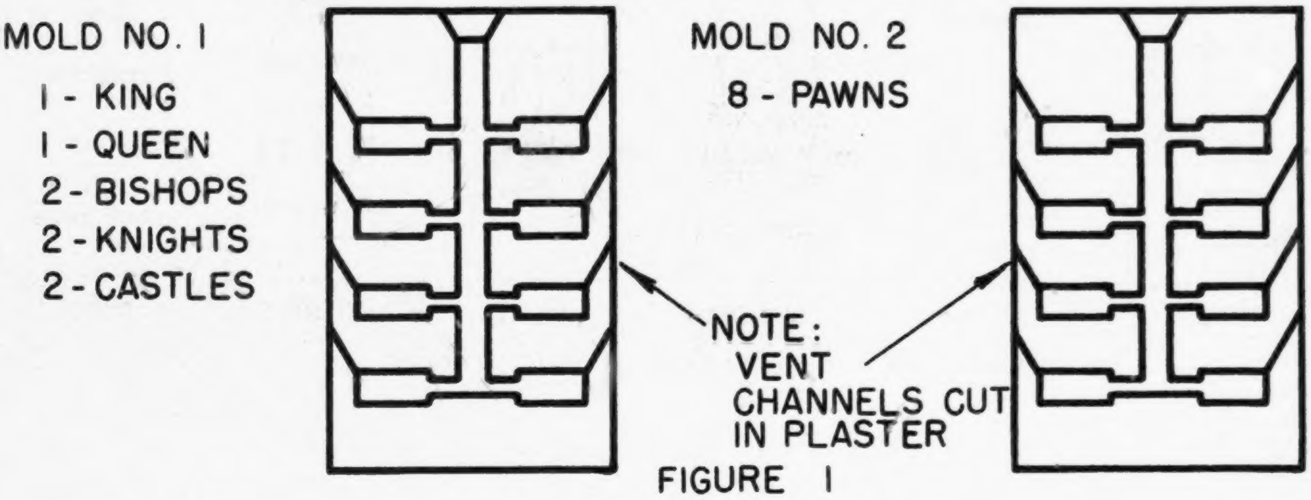


FIGURE 1

Add clay to link models with main and branch slip channels.

Set cottles and pour plaster for first half of molds. Remove clay bed and size all plaster surfaces.

Add clay to fully form the main and branch slip channels.

Reset cottles and pour second half of molds.

Separate mold sections, remove models and clay channels, cut in thin vent channels. Dry mold.

Fill securely tied, clean, dry molds with slip.

Open molds and remove ganged casting when slip has stiffened.

Cut off each casting and fettle.

Cast another complete set and prepare for bisque fire.

Bisque fire all the dry pieces.

Glaze the pieces, one set dark, the other with a light-colored glaze.

Glaze fire the pieces.

Related Technical Information

Waxes Used for Ceramic Models:

The use of wax in ceramics is dependent upon its characteristics. Animal, plant, mineral (petroleum), or synthetic waxes all display varying degrees of the same characteristics, namely; resistance to water and its vapor, tensile strength, ductility, hardness, gloss, moldability, ability to emulsify, solvent retention, and melting range.

Commercially available waxes are generally combinations of waxes tailored to fit a specific application. In ceramics there are three applications of importance.

Models: Original or duplicate models of hard pattern wax can be easily carved, turned, or cast to provide sharp, smooth, durable models for mold making. This wax is generally 50% paraffin plus varying proportions of plant waxes, such as carnauba, palm, and candelilla; animal wax such as beeswax and spermaceti; and synthetic resins.

As a resist for stencil decoration: Utilizing the emulsifying water resistance and low melt characteristics of waxes, a group of emulsions known as *"ceresins"* have been developed. These can be used either on green or bisqued clay making possible easier resist decoration with engobes, underglaze colors, or glazes. Ceresins volatilize at about red heat leaving no detrimental residue.

As a final finish: Waxes such as shoe polish are used as sealers for bisque sculpture. This type of wax is mostly carnauba plus cheaper waxes combined with dyes for color.

Further experimental work is being conducted with ceresins and their possible application as additives to minimize glaze defects.

Other topics to explore:

Use of Gang Molds in Industry
Investment Casting
Types of Plaster Best Suited for Molds

Demonstrations

Turn a plaster model on a lathe.
Make a two-piece block mold.
Make a gang mold.

Related Cultural Information

History of Chess:

Scholars agree that the game of chess was conceived in Asia. Here the agreement ends. Though the modern game derives its name from the Persian word "shah," meaning king, some scholars, with evidence to support their claim, give credit to the ancients of India for originating the game. Other scholars give the credit to the Persians. While invading and conquering Persia the Moslem Arabs of the 7th century learned the game from their captive hosts. As they continued their invasions and conquests across North Africa, the Mediterranean, and finally Spain, the Moors brought with them much of the culture of the people they had subjugated. Thus through war, was the game of war along with many ceramic developments of Persia, introduced into Europe. Benjamin Franklin has been given credit for popularizing the game in the United States. Today, interest in the game is on a worldwide competitive basis with the United States and Russia as the current leading contenders for the world championship.

Other topics to explore:

Cultural Influences of the Moors
History of Other Games
Derivation of Chessmen Design

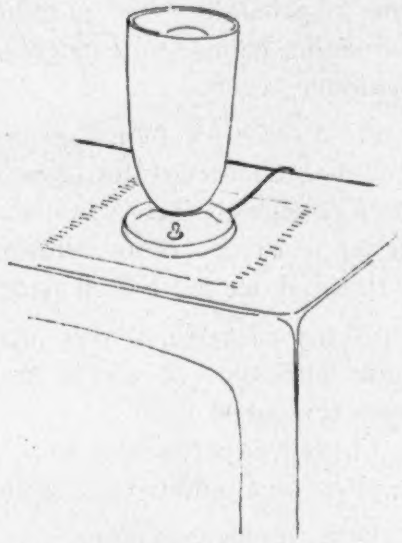
References

Binns, C. F. *The Potter's Craft*. pp. 49-54
Jenkins, R. H. *Practical Pottery*. pp. 39-42

SLIP CASTING

TV LAMP

A well-designed lamp can brighten a dark corner or wall in any room. This basic clay shape can be utilized in many ways to provide a source for spot or indirect lighting.



Working Drawing

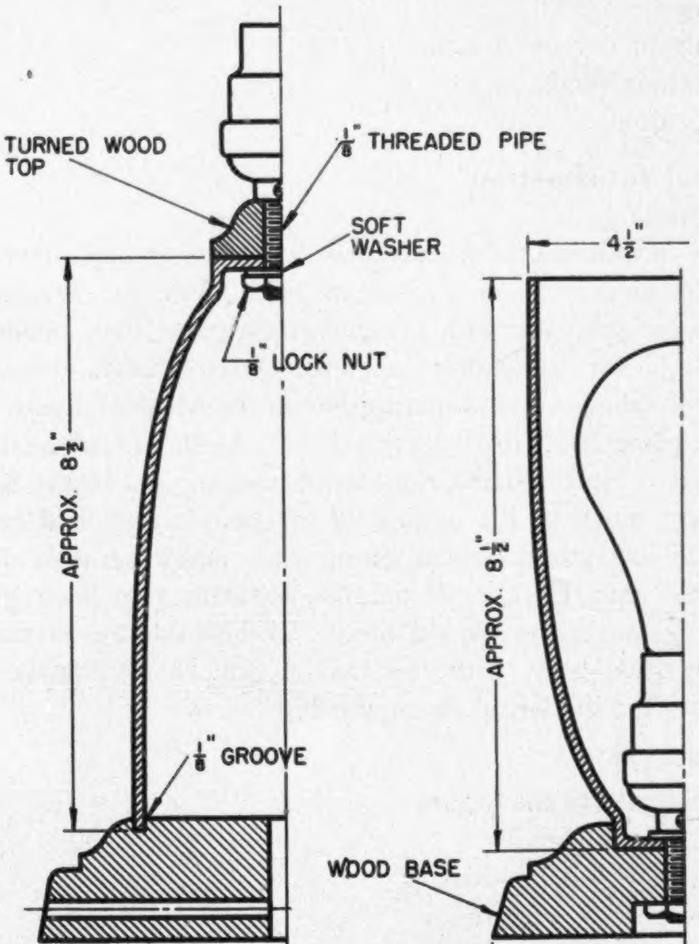
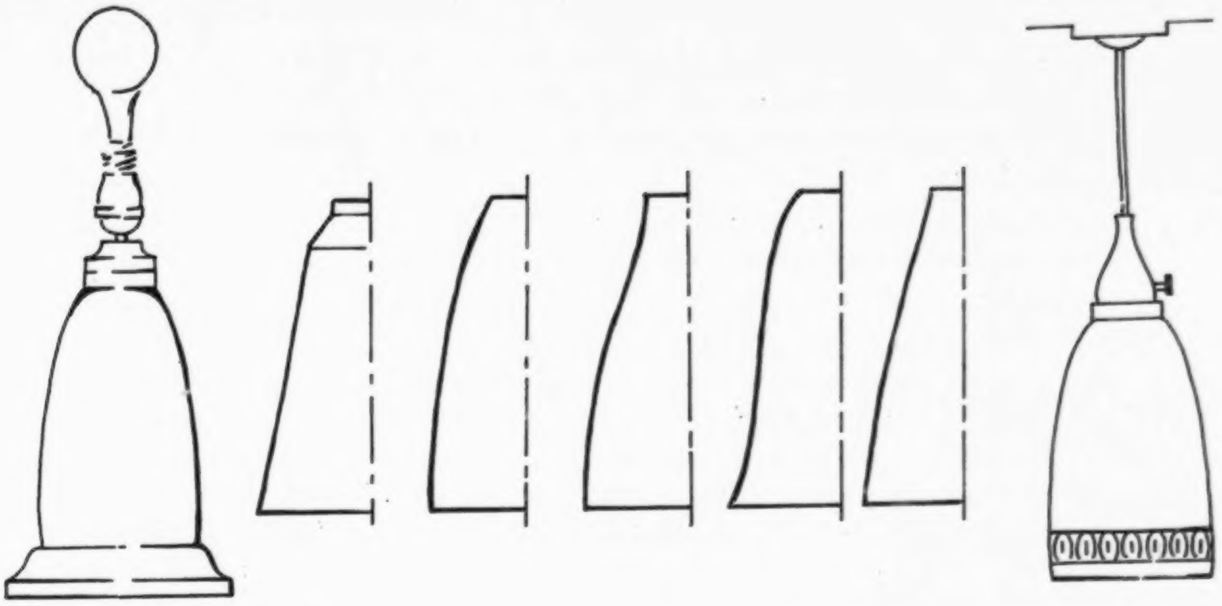

TURNED WOOD TOP
1/8" THREADED PIPE
SOFT WASHER
1/8" LOCK NUT
APPROX. 8 1/2"
1/8" GROOVE
APPROX. 7 1/2"
4 1/2"
APPROX. 8 1/2"
WOOD BASE
APPROX. 5"

TABLE LAMP

T V LAMP

Alternate Designs



Research Activities

Sketch 8 or 10 trial shapes at the blackboard, for an indirect TV lamp.

Roll a sheet of paper into a cone and try changing its height and the diameter of its base until a desired proportion is reached.

Contrast wood lamp parts with clay and glaze samples. Select materials that complement each other and fit in the room where the lamp will be used.

Experiment with other adaptations of the basic clay shape. Try using it as a pendant or spot-lighting fixture.

Procedure

Make model of basic clay shape. (Use clay, wood, or plaster. See unit, Turning Box.)

Cast one-piece plaster mold of model. (See *The Complete Book of Pottery Making*, pp. 74-76.)

When the mold has dried, cast clay shape, dry fettle, and fire. (Some slip clays are suited to one-fire glazes.)

Turn wood parts on lathe, fitting clay to wood. (Avoid tight fit which may crack clay part.)

Finish wood parts before assembly.

Assemble and wire, use rubber or cork washer between clay and lamp socket or nut to avoid strain on pottery.

Related Technical Information

Making and Controlling Plaster:

The raw material of plaster is gypsum rock with the composition $CaSO_4 \cdot 2H_2O$. This rock is finely ground and calcined or heated to approximately 350° F which drives off the water of crystallization and produces $2CaSO_4 \cdot H_2O$. This is the plaster the potter uses. When water is added to this plaster, it recrystallizes to form the $CaSO_4 \cdot 2H_2O$ of the original rock.

Number 1 pottery plaster in 100-pound bags is best for ceramics work. Purchase fresh plaster and store in moistureproof container.

Gypsum plaster sets rapidly; sometimes it becomes necessary to add certain materials to change the setting time. Some retarders that are used to slow the setting are citric acid, cream of tartar, and glue sizing. To speed up the set, accelerators such as alum, lime, Portland cement, or ground plaster may be used.

Another topic to explore:

Commercial Uses of Plaster

Demonstrations

Make models of clay, wood, or plaster.
Make a one-piece mold.
Pour slip.
Apply glaze.

Related Cultural Information

Plaster of Paris:

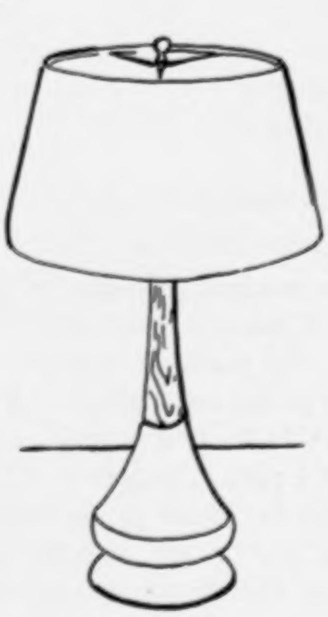
Calcined gypsum or gypsum plaster was used in Egypt before 3,000 B.C. It is often called plaster of paris because one early and important European source was a suburb of Paris, France. Gypsum plaster is not only important to the ceramic industry as a mold material but is also used extensively as a building material in blocks, wallboards, and plasters.

References

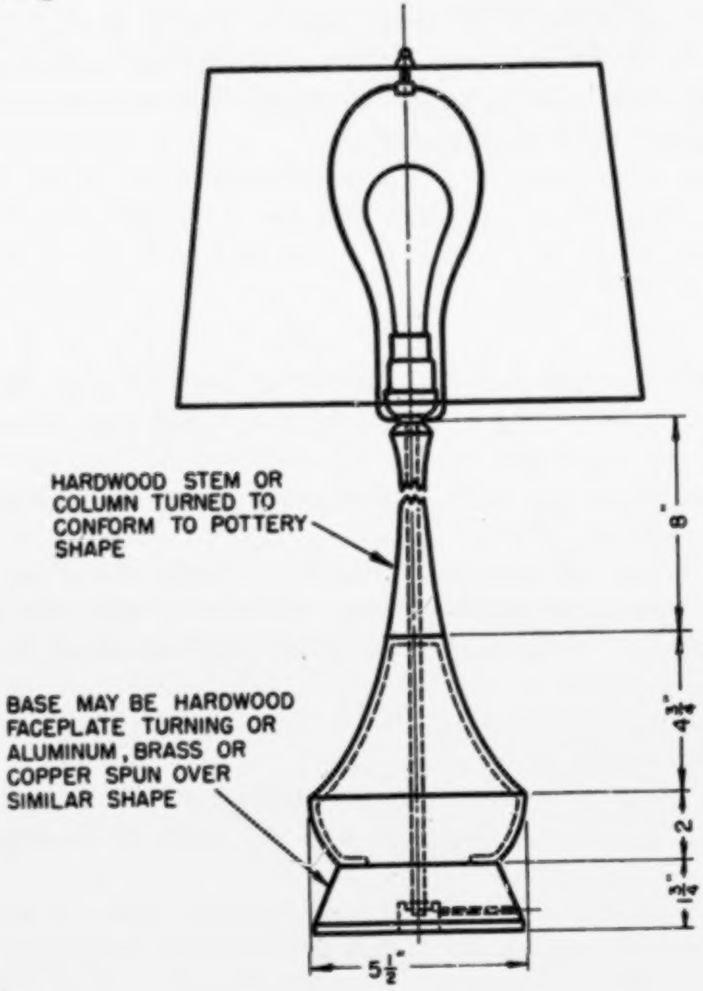
Kenny, J. B. *The Complete Book of Pottery Making*. Chapters 5, 6
Norton, F. H. *Ceramics for the Artist Potter*. Chapters 13, 14
The University of the State of New York. *Ceramic Area Related Information*. pp. 83-84

TABLE LAMP

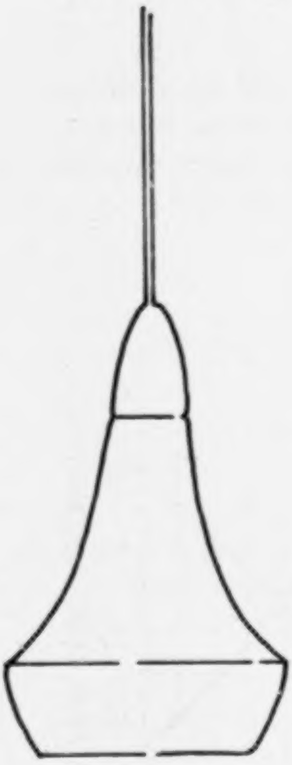
A table lamp for reading or general illumination can be made in shop for a small fraction of the cost of a similar item in the stores. Wood and metal can be tastefully employed for the base or column to enhance the clay and glaze.

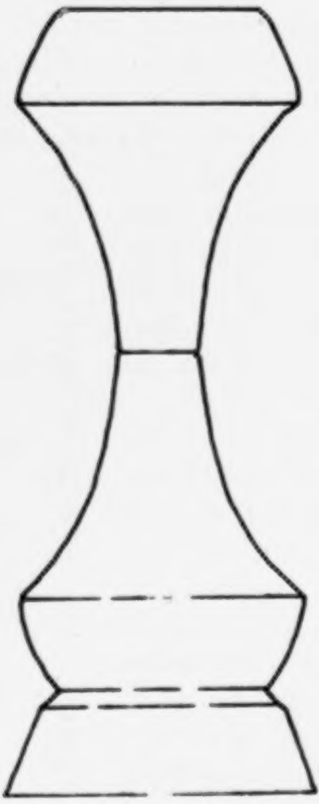


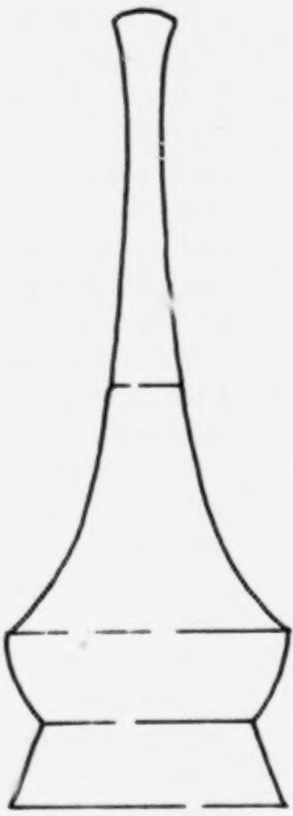
Working Drawing


HARDWOOD STEM OR COLUMN TURNED TO CONFORM TO POTTERY SHAPE
BASE MAY BE HARDWOOD FACEPLATE TURNING OR ALUMINUM, BRASS OR COPPER SPUN OVER SIMILAR SHAPE
8"
4¾"
2
1¾"
5½"

Alternate Designs







Research Activities

Note the particular space in the room where a lamp is needed, check the height of the table or stand, the color and texture of furnishings and plan a lamp to fit.

Inquire at the local electric power company office for booklets or charts on proper lamp heights, shade proportions, etc.

Scan mail order catalogs for typical lamp dimensions and shade sizes and shapes.

Try partially filling a hollow slip cast lamp base with sand for increased stability.

Design a shape that will serve alone as a container, or as a base for a small lamp, and doubled as a table lamp.

Procedure

Make a full-size working drawing (profile) of intended lamp shape.

Form wood or plaster model for basic clay shape (see unit, Turning Box) using template taken from working drawing.

Cast two-piece mold over model, allow mold to dry thoroughly. (See *Pottery Made Easy,* pp. 75-80.)

Make one or more slip castings of basic clay shape. (See *Pottery Made Easy,* pp. 95-96.) Cut hole for electrical wire or conduit; dry, fettle, and fire.

Apply glaze and fire. Note: A plain mat glaze which can be applied to greenware is appropriate for this project.

Prepare block of appropriate hardwood and turn to size and shape for base. Apply finish while on lathe.

Prepare and mount matching hardwood billet for column, turn to size and shape, check it repeatedly against clay piece for conformity and size; finish to match base.

Bore holes in column and base for ⅛-inch threaded pipe and lamp cord.

Assemble, taking care not to crush clay portion when tightening locknut. Select harp, and shade carefully.

Related Technical Information

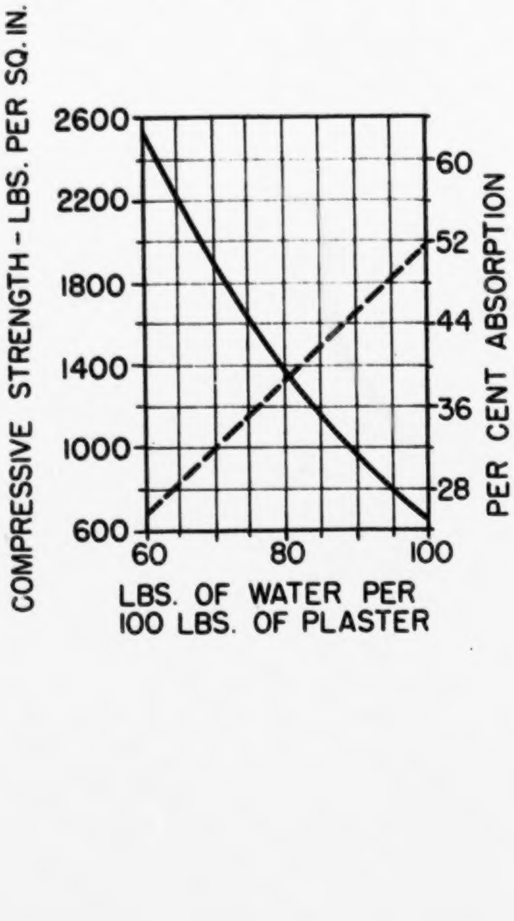
Mixing Plaster:

All mixing equipment should be clean, free from "set" cement and other foreign material. This is important as "set" cement will accelerate the "set" of the new mix. Measure or weigh the water, weigh the plaster. Sift or strew the plaster into the water evenly, avoid dropping handfuls of plaster into the water at one time.

Allow to soak or slake for 2 minutes undisturbed, then mix thoroughly. Stir from the bottom, forcing the material to the top. Care should be taken that no air is beaten into the mix during this process. Keep mixing until a smooth, even mass is produced.

For typical use in ceramics work the following proportions of water and plaster will yield fairly strong molds having good absorbency: To 1 quart water add 2¾ pounds plaster—yield approximately 80 cubic inches.

This graph indicates how increasing the relative amount of plaster will result in harder, less absorbent molds while decreasing it will produce softer, absorbent molds.



Demonstrations

Make models or patterns.
Do faceplate and spindle turning.
Make a two-piece mold.
Pour slip castings.

Related Cultural Information

Lighting and Lamp Design:

Local lighting is needed near easy chairs throughout the house, or on desks and tables at which any writing or close work is to be done. A high level of illumination should be provided by lamps at each end of a long sofa; sewing and game areas should also be well lighted.

In general, tall lamps spread their light better than short ones, and shades wider at the bottom than at the top spread the light better than drum-shaped ones. Shades lined with white reflect most of the light to where it is needed. Lamp shades should be dense enough to keep the bulb from being seen through them as a bright spot. Diffusing bowls beneath the bulbs soften the light.

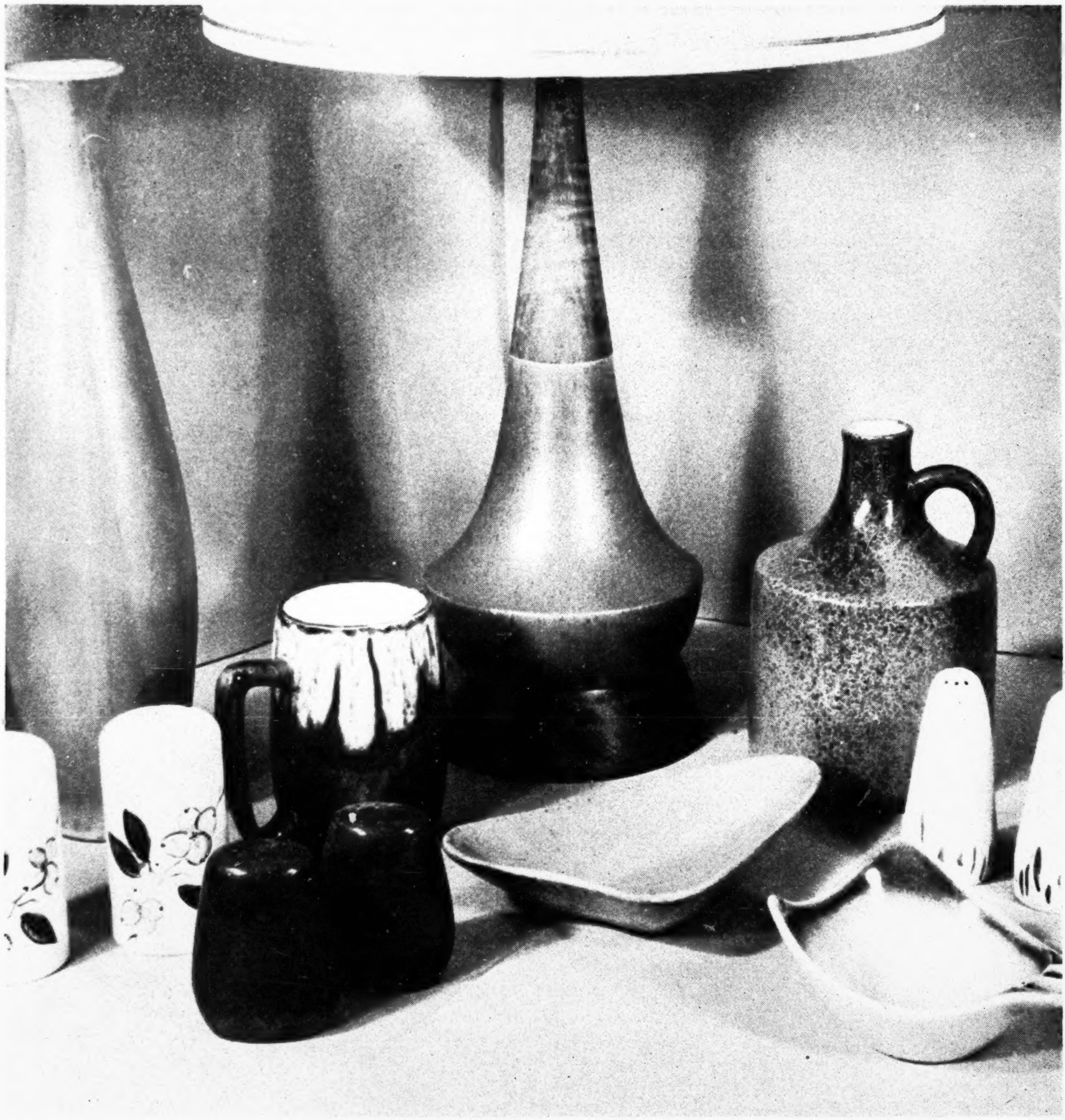
The height of the lower edge of the shade from the table or desk should be between 15 and 17 inches. The diameter of the lower edge of the shade should be approximately 16 inches and the top diameter approximately 9 inches. For a 200-300 watt bowl the top shade diameter can be approximately 14 inches. The shade should conceal the bulb and fixture when viewed at eye level.

Other topics to explore:

Lighting Methods Through the Ages
Cost of Lamps

References

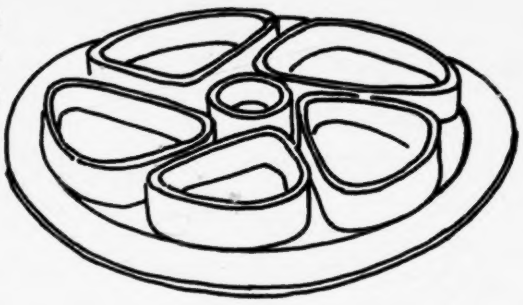
Dougherty, J. W. *Pottery Made Easy*. pp. 75-96
Norton, F. H. *Elements of Ceramics*. pp. 212-213



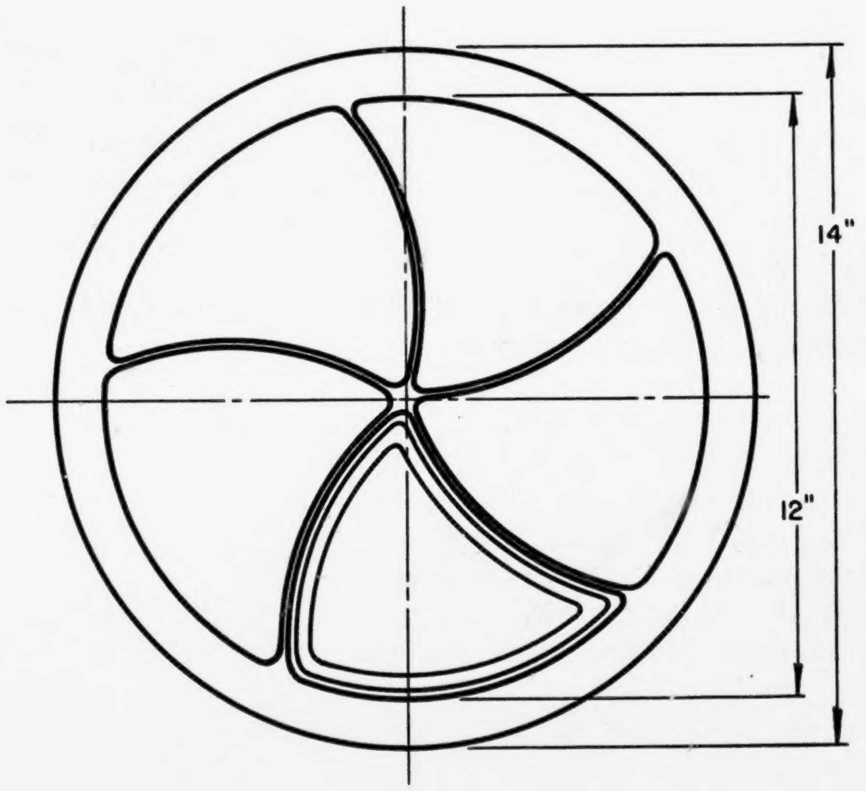
Slip cast pieces from original molds.

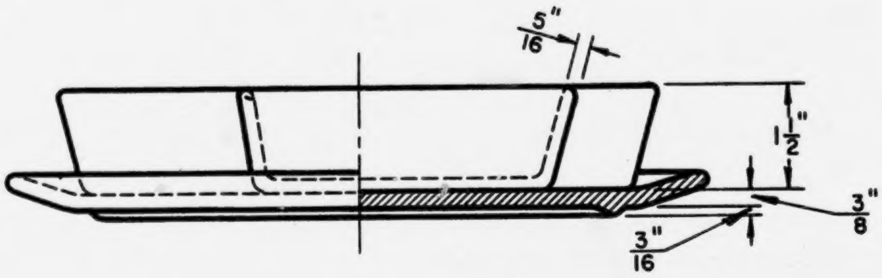
LAZY SUSAN SET

For economy of space, this relish dish set and tray provides an answer for the informal serving problems of the modern homemaker for buffet dinners and picnics.



Working Drawing





Research Activities

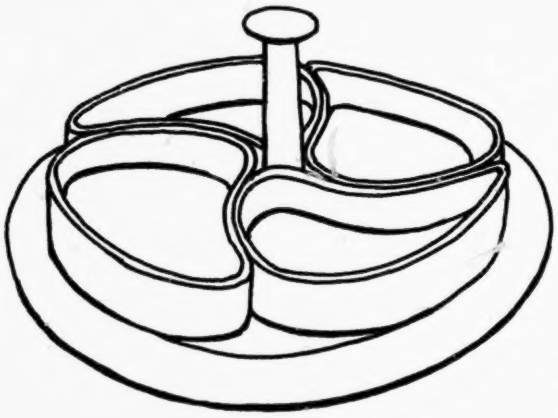
Experiment with various combinations of shapes for the individual dishes by drawing full-size sketches.

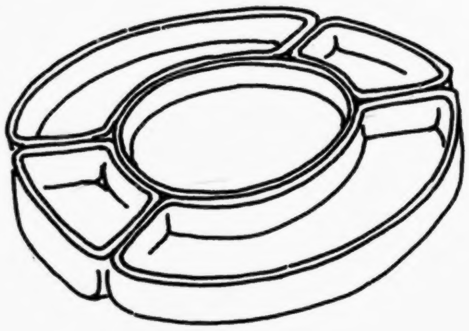
Try using wood or metal handles for the ceramic tray.

Design a wooden or metal lazy susan tray.

Sketch several possible surface decorations for the outer edges of dishes or tray such as texturing or simple line designs.

Alternate Designs





Procedure

Make a full-scale drawing of the dish form and tray. (Allow for shrinkage.)

Make the model of the dish.

Using ⅛-inch tempered Masonite make template cutter from side view of full scale drawing. (See figure 1.)

Make pattern of dish from top view of drawing also using Masonite.

Make bridge sled and mount template cutter. (See figure 2.)

Mix and pile plaster directly on sized Masonite pattern.

Using pattern as guide, cut plaster to shape with template cutter. (See *Complete Book of Pottery Making,* p. 143.)

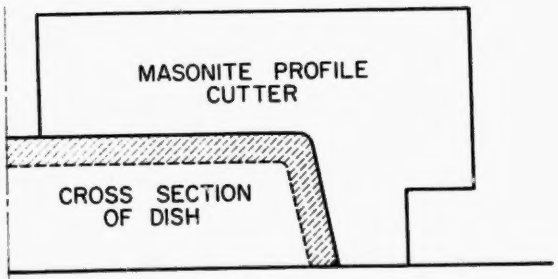


FIGURE 1

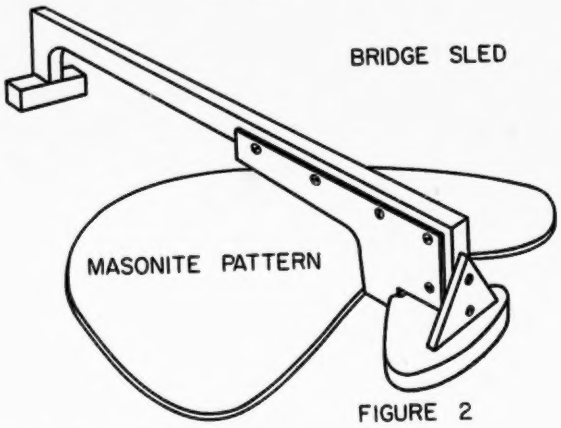


FIGURE 2

Make the mold of dish.

Size and place the model of the dish on a clean casting surface.

Place appropriate cottle about model and seal base to prevent plaster leakage.

Mix and cast plaster over model.

Remove cottle when plaster sets allowing at least one-half hour for final set.

Carefully remove model and allow mold to dry overnight.

Make dishes.

Using casting slip make required castings from drain mold.

Fettle and dry castings.

Bisque fire the dishes.

An effective simple decoration of this set can be achieved by using two complementing colors of glaze, one for the inner surfaces and the other for the outer.

Glaze fire the dishes.

Make tray on potter's wheel.

Throw tray with careful attention to diameter and depth of well. Check with calipers.

Remove tray from wheel and allow to dry to leather-hard condition.

Invert leather-hard tray and remount on wheel.

Turn base and foot rim. Check diameter carefully with calipers.

Remove and dry carefully.

Bisque fire.

Apply colored glaze to match interior color of dishes.

Glaze fire.

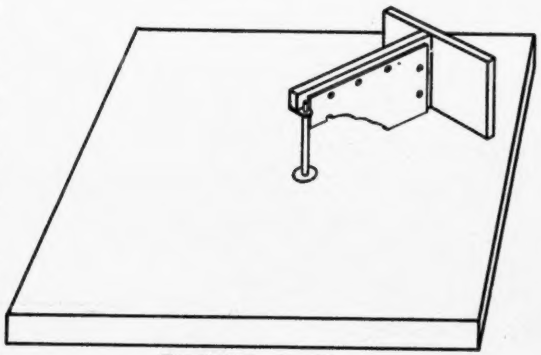
Related Technical Information

Turning Sleds:

Two alternating turning sled designs are available making possible the forming of both symmetrical and irregularly shaped plaster models for bowls or dishes.

For symmetrical forms, the turning sled slides around a pivot post mounted on the working surface. (See figure 3.)

The maximum size of the model is governed by the length and height of the sled arm. The finished size and shape of the turned model is provided by the template cutter which is mounted on the sled arm for turning.



TURNING SLED
FIGURE 3

The bridge sled (figure 2) provides its own support. In forming a model the sled base must bear against the edge of a pattern of the model. The pattern can be cut from ¼-inch plywood or Masonite. The base of the sled should be designed so that it can bear against any irregular curve of a pattern.

Demonstrations

Develop template design from full scale drawing.

Make Masonite template.

Make bridge sled.

Make model using template and bridge sled.

Use adjustable casting box for casting plaster molds.

Related Cultural Information

Function Shapes Pottery:

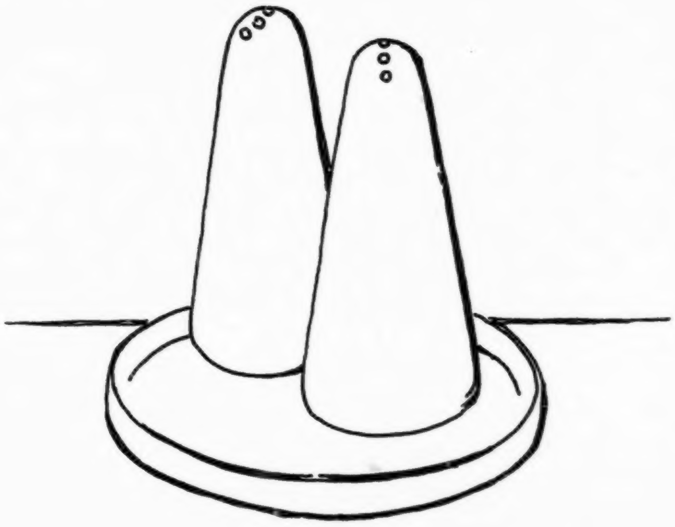
The functional shaping of pottery forms, as demonstrated by this group of interlocking dishes, is a simple modern application of design technique instituted by the earliest of potters. All through history excellent examples of functional design are apparent. One such good example is the pointed bottoms of the pottery of Ancient Middle East nomadic tribes. To be supported these ceramic containers were simply driven into the soft desert sands. The incorporation into the design of loop handles and constricted necks permitted the fastening of hide covers and also the means of tying the pottery onto pack animals for transportation.

Reference

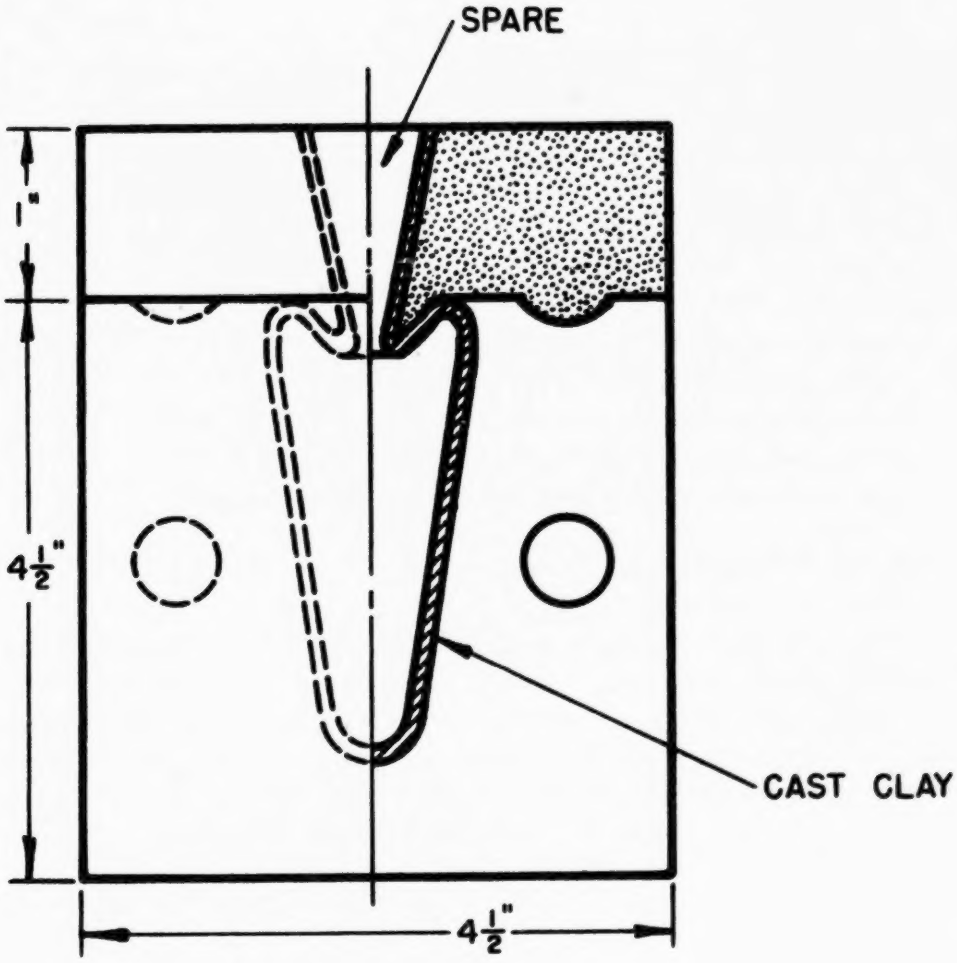
Kenny, J. B. *The Complete Book of Pottery Making.* pp. 143-146

SALT AND PEPPER SHAKERS

A salt and pepper shaker set is an interesting project to make for informal table setting. It entails the use of a model, a waste mold and a three-piece drain mold.

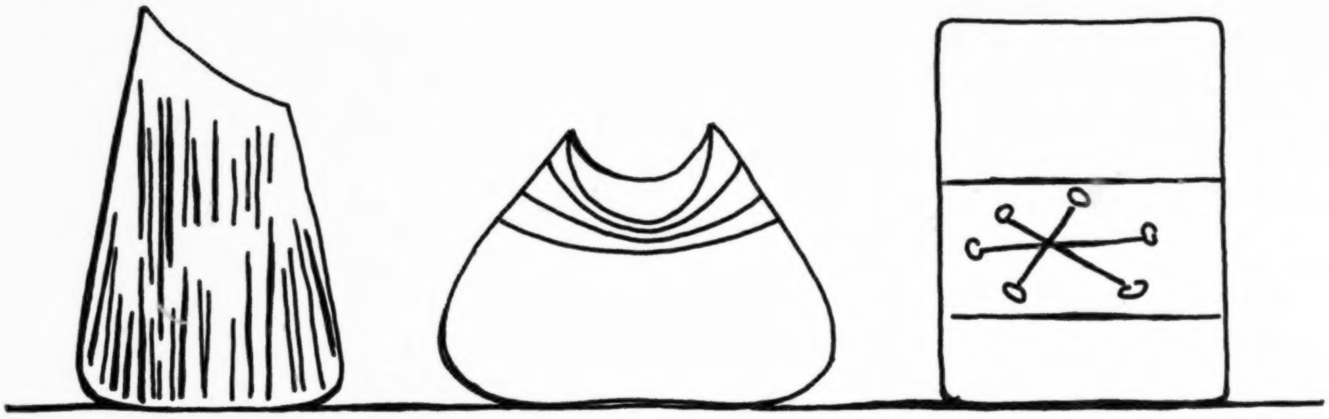


Working Drawing



THREE PIECE MOLD

Alternate Designs



Research Activities

Search for adaptable designs.

Create designs to suit a special occasion.

Experiment with sizes and types of stoppers for shakers.

Determine number and size of shaker holes for best uses.

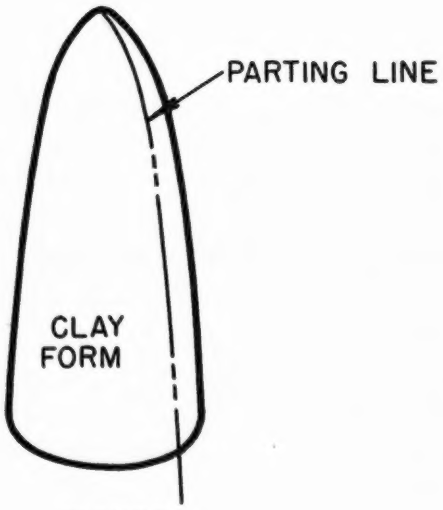


FIGURE 1.

Procedure

Shape form of design using plastic clay.

Determine parting line and insert shim stock all around it. (See figures 1 and 2.)

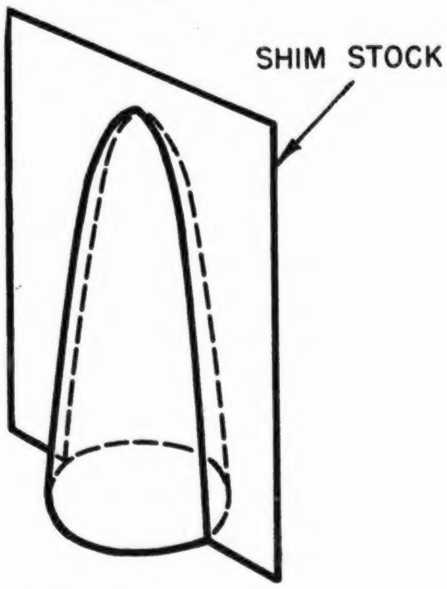


FIGURE 2.

Mix plaster, brush and spoon onto form to make waste mold. (See figure 3.) (See also *Ceramic Sculpture*. pp. 105-110.)

Open waste mold, remove clay form, clean and size plaster.

Close and bind waste mold, fill with plaster to make model.

Refine detail of plaster model.

Imbed model in clay to parting line. (See figure 4.)

Size model and cottle.

Set cottle, mix plaster, and pour first section of mold.

Remove clay bed, clean plaster, cut joggles.

Reset cottle mix and pour plaster for second section. (See figure 5.)

Stand completed sections on end, cut joggles, shape and position clay spares. (See *Ceramics for the Artist Potter*, p. 35.)

Reset cottle and pour last section of mold. (See figure 6.)

Pour prepared slip into mold for casting.

When able, remove casting and pour slip for a second casting.

Fettle and sponge castings.

Decorate with underglaze.

Bisque fire pieces.

Glaze bisque ware using colorless transparent glaze.

Glaze fire pieces.

Related Technical Information

Deflocculation of Clay:

Successful slip casting is generally assured with the use of a smooth fluid slip which sets up rapidly, does not settle in the mold, drains smoothly, releases quickly and cleanly, trims well, has good dry strength and a minimum percentage of shrinkage. Water in excess of 50 percent when added to a clay to form slip adversely effects setup and releasing time, settling, and shrinkage. It is desirable to have as low a water content as possible in slip and still retain all the above characteristics.

To reduce the proportion of water, various electrolytes have been employed to deflocculate clay slip. The electrolytes effect the electrostatic forces which nor-

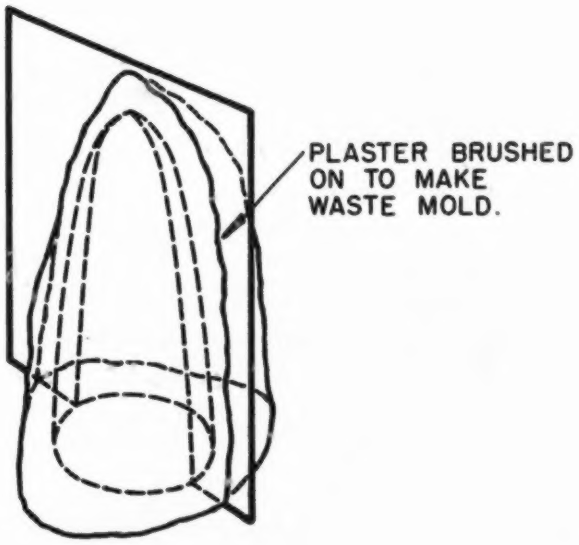


FIGURE 3.

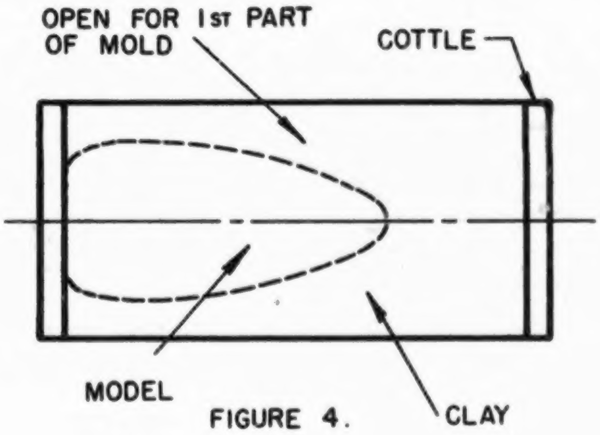


FIGURE 4.

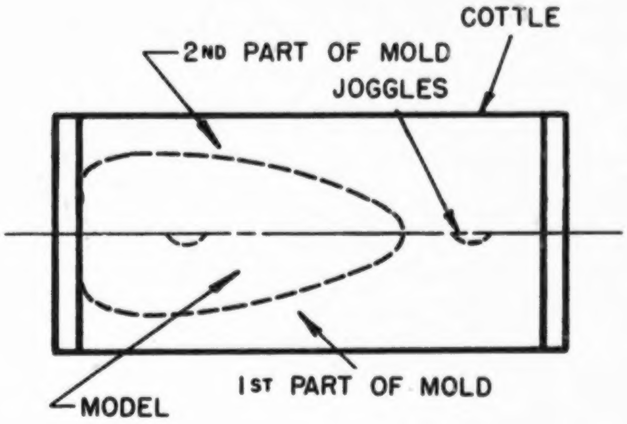


FIGURE 5

mally cause clay particles to clump together. It disperses these particles. Deflocculation thus makes fluidity of a slip attainable with less water.

Unfortunately all clay bodies do not deflocculate uniformly. Some will respond to one electrolyte and not another. Other clays respond to a combination of electrolytes, while still others can not be deflocculated at all. Among electrolytes used are sodium hydroxide, sodium pyrophosphate, and tetrasodium pyrophosphate.

To determine whether a clay can be deflocculated and the amount of electrolyte required, the following testing procedure is recommended: Divide 500 grams of crushed clay, screened through a 60-mesh screen, into one 200-gram and six 50-gram portions.

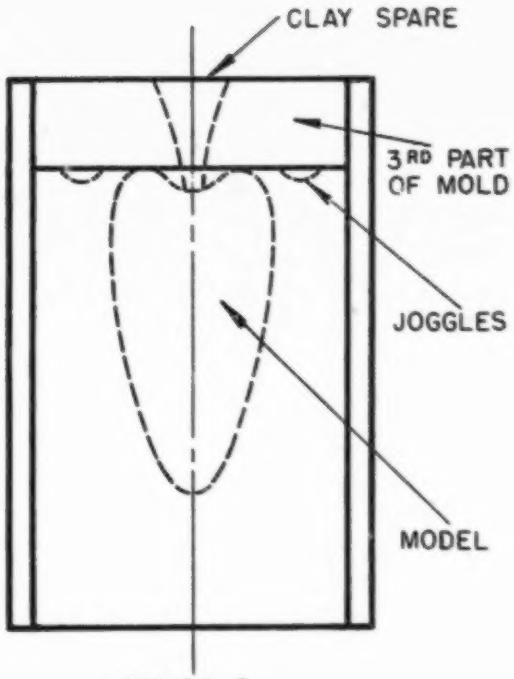


FIGURE 6.

To 200 milliliter of water add the 200-gram batch of clay and mix to a slip. If the resulting slip is thin, add clay until the mix becomes almost too viscous to pour. At this point, add 1 milliliter of 50 percent sodium silicate (50 percent water) and mix again, noting the thinning effect of the viscosity of the slip. The procedure of adding more clay and then sodium silicate is continued until all the clay is used, noting carefully how much electrolyte is finally used to get the desired pouring consistency.

The slip should be allowed to stand 10 minutes to see if it thickens or jells. A jelled slip too slow for casting would indicate that too much deflocculant has been added and would have to be altered.

Demonstrations

Shape clay model.
Make a plaster waste mold.
Mix potter's plaster.
Pour a plaster model.
Make a three-section drain mold.

Related Cultural Information

Salt:

In all the varied cultures of man, from the dawn of his birth on this planet to the present, the white crystals of common salt have always in some way influenced his life. The physical necessity for salt is recorded in the earliest written records of man. The Bible has more than 30 references to salt. Its importance has been such that it has been a religious symbol for Hebrews and Christians alike. Amongst the oriental civilization salt has been and still is a sign of friendship. The Arabs say, "there is salt between us," meaning we have eaten together and we are friends. History relates many tales, pointing out its importance in stories of Germanic tribal wars for possession of sacred salt springs.

As an economic commodity of prime importance history attributes the development of some trade routes to the availability of salt. The Asian trade route to India and the military Via Solaria of Italy are but two of many examples. The scarcity of the commodity, upon occasion, led to its use as money. Caesar paid his mercenaries with salt indicating the derivation of the word salary from "salarium." It is still a medium of exchange in the South Seas and Africa.

As a migratory factor affecting peoples, we need only to look at the history of the American Indian where numerous examples of tribal migrations were directly attributed to the search for, acquisition, or retention of salt deposits or springs.

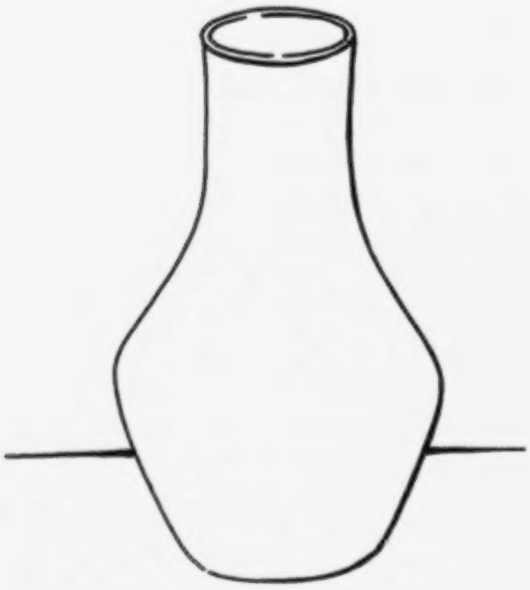
It is curious to note that today, salt has 14,000 uses but of the total world production only 5 percent is used as a food.

References

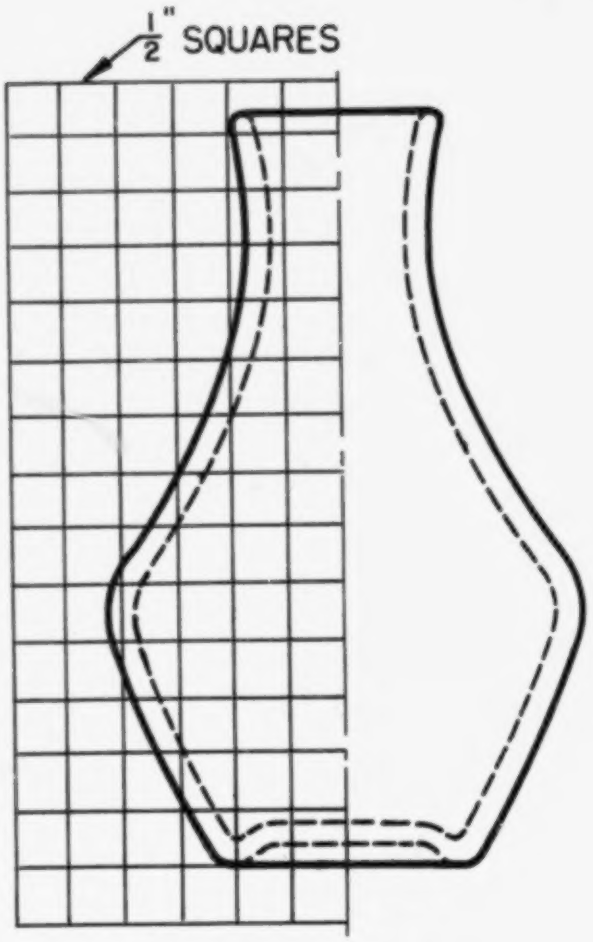
Bellaire, Mark. *Underglaze Decoration*
Kenny, J. B. *Ceramic Sculpture*. pp. 105-110
Norton, F. H. *Ceramics for the Artist Potter*. p. 35

VASE

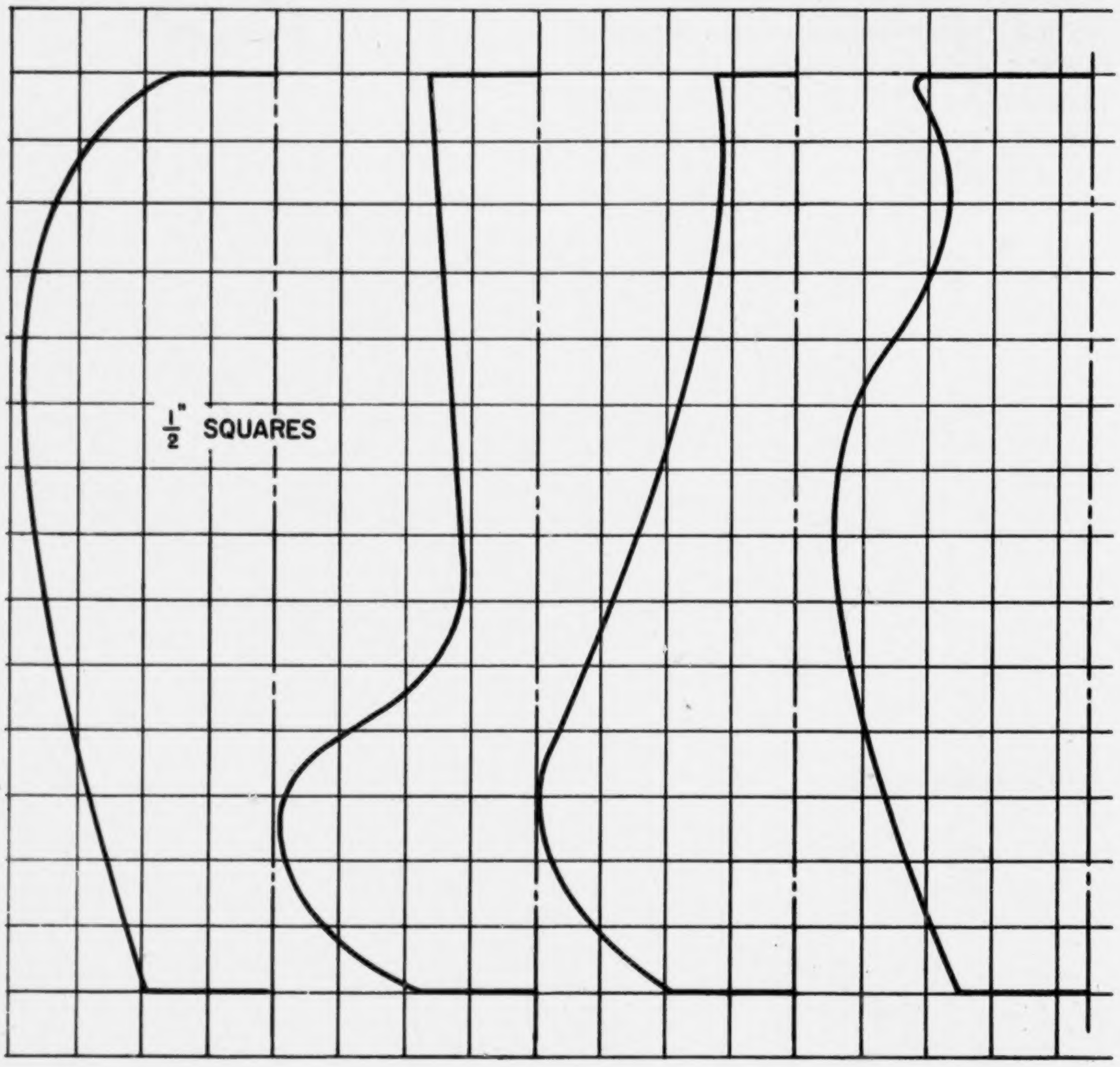
The cylindrical object presents the opportunity of an original design for an industrial production project, or for the individual matched set. Variations may be obtained through the use of different decorating techniques.



Working Drawing



Alternate Designs



Research Activities

Experiment by building up shapes using plaster at the point of plasticity.
Create vase designs using a French curve.
Make a pictorial or sketch collection of period vases.
Devise a chuck for turning plaster on a wood lathe.

Procedure

Design vase full size on paper allowing for shrinkage.

Cut away the true center of the vase to allow for the radius of the turning shaft. (See figure 1.)

Adhere pattern to metal.

Cut and file metal template to shape. (See unit, Turning Box.)

Cut template backing and fasten template.

Mount template and backing in the turning box.

Wind a single layer of light cloth with shellac, the entire length of pattern. (See figure 2.)

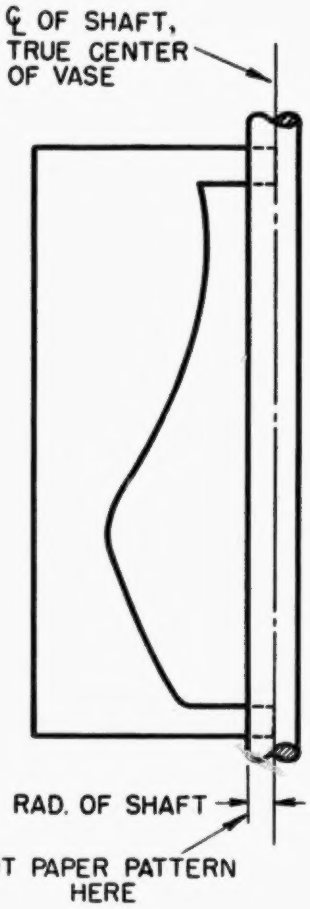

℄ OF SHAFT, TRUE CENTER OF VASE
RAD. OF SHAFT
CUT PAPER PATTERN HERE

FIGURE 1

Wind fibrous cloth strips (old towel or burlap) on shaft using shellac and string. Start approximately ½ inch in from top and bottom of pattern. (See figure 2.)

Build up cloth to approximate shape of vase allowing for the building up of plaster (See figure 2.)

Mix plaster and test for period of plasticity.

Spoon and trowel plaster on rotating cloth-covered shaft. (See *Ceramics for the Artist Potter*. pp. 172-175.)

Repeat until pattern is formed by rotating against the template.

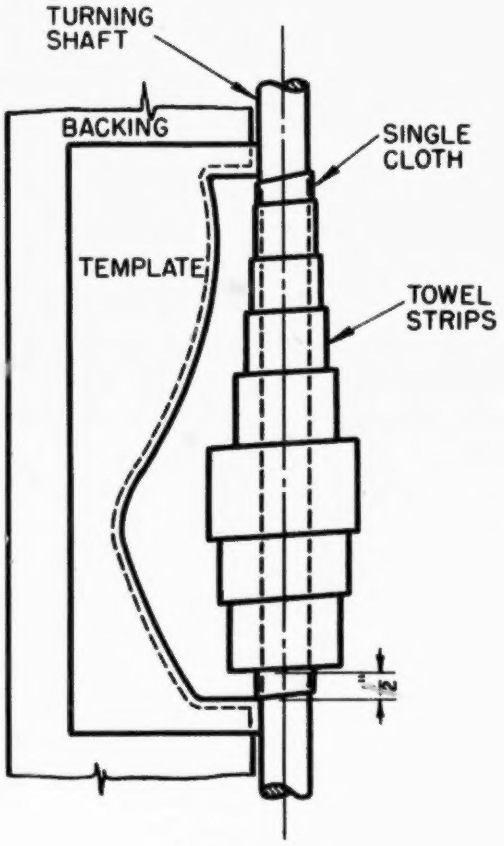

TURNING SHAFT
BACKING
SINGLE CLOTH
TEMPLATE
TOWEL STRIPS
½

FIGURE 2

Turn foot by hand, by rotating pattern against plaster tool. (See figure 3.)

Remove the template and backing from the box.

Shellac and polish pattern to insure waterproofing.

Make a mold from the pattern.

Slip cast vase.

Fettle, sponge, and allow to dry.

Bisque fire.

Apply glaze.

Glaze fire.

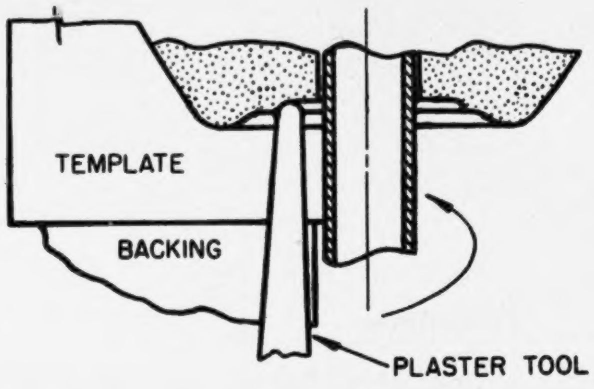


FIGURE 3

Related Technical Information

Plaster's Plastic Period:

Plaster is used in box turning to build up shapes and patterns during its period of plasticity. The plaster can be controlled during this progressive setting period without the forms that are required to hold it during its pouring stage.

The plaster, after mixing, is free flowing. Later it begins to thicken and have enough body so that it may be shaped or formed with a spoon and spatula. The spoon may be used at the beginning of the plasticity period and the spatula toward the end of the period. The period of plasticity is over when bonding is difficult and crumbling takes place. It is suggested that an experimental shape be formed on the plaster bench by piling the plaster with a spoon and spatula.

Other topics to explore:

Carving Plaster

The Use of Plaster for Pattern Making in Industry

Demonstrations

Use the period of plasticity of plaster.

Lay out a template.

Develop proportions in designing a vase.

Turn a pattern.

Cut a foot using the turning box.

Related Cultural Information

Vases in History:

A vase is a hollow vessel, usually rounded and higher than it is wide. It is a household decorative piece with graceful lines mainly used to hold flowers. Vases have been made throughout history. The discovery of an ancient vase can reveal the culture of its period. Pieces of pottery were often enclosed in burial tombs. The portland vase found near Rome during the 1600's was in a tomb of Alexander Severus. Wedgwood often copied designs from antique pottery and glass. The most famous of these is Wedgwood's "The Portland Vase."

Other topics to explore:

Shapes of Vases of Various Cultures

Various Types of Glazes and Surface Decoration Used by Ancient Cultures

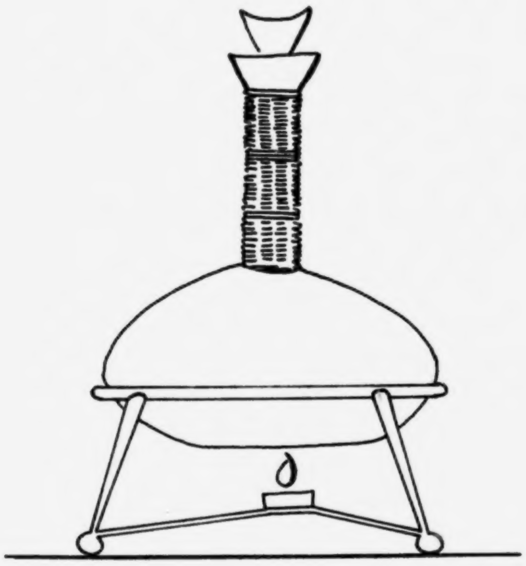
References

Binns, C. F. *The Potter's Craft.* p. 74

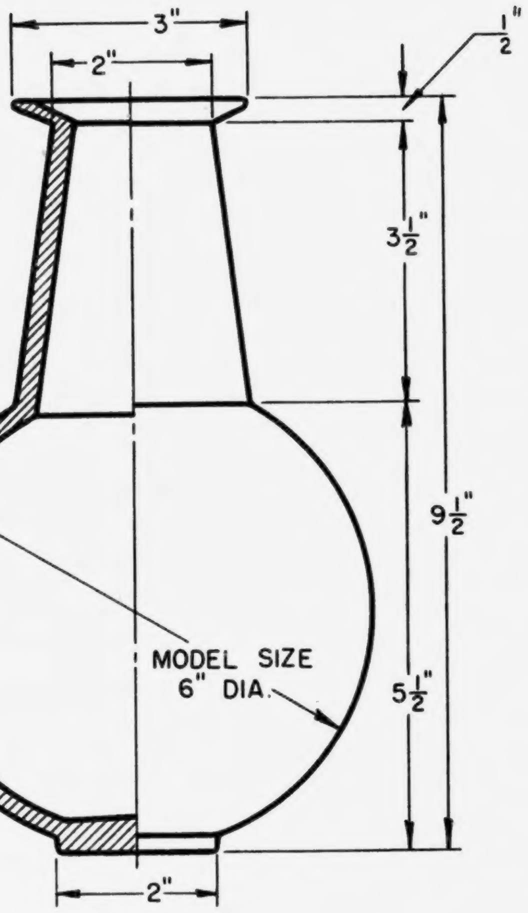
Norton, F. H. *Ceramics for the Artist Potter.* Chapter 19

COFFEE WARMER

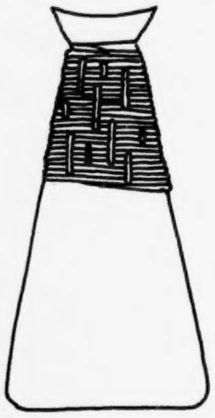
In keeping with the tendency towards leisure living a coffee warmer will go far towards creating a pleasing effect as well as serve the practical need of keeping the second cup of coffee warm on the table. Used with a wire base or a wire and wood handle this becomes another interesting combination-type project.

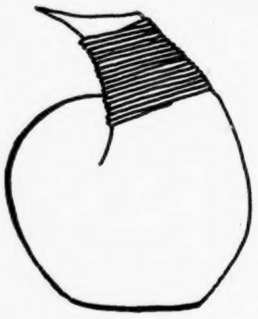


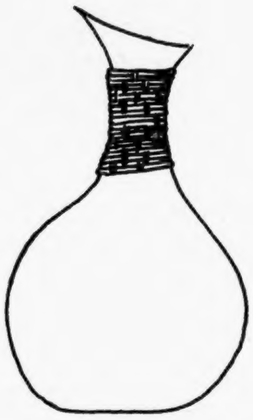
Working Drawing

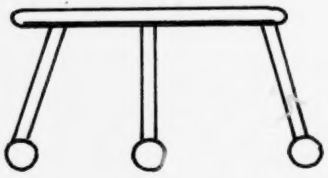

3"
2"
$\frac{1}{2}$"
$3\frac{1}{2}$"
$9\frac{1}{2}$"
MODEL SIZE
6" DIA.
$5\frac{1}{2}$"
2"

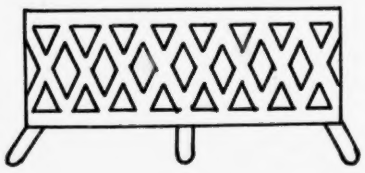
Alternate Designs

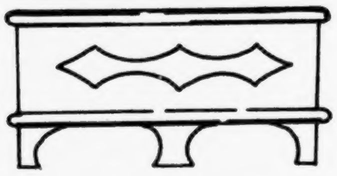












Research Activities

The lower portion of the coffee warmer is a sphere with a small flat bottom. No foot is recommended because it is a cast object and a foot might produce an objectionable corner to clean. The neck may appear too generous at first. At best this is a compromise between appearance and utility. Being fairly large the neck is easy to clean and is quite efficient for refilling purposes. The wide flaring lip makes it possible to get a grip on the neck. If the bare neck is uncomfortably hot, it may be insulated in a variety of ways.

Procedure

Make full scale drawing of outside profile of coffee warmer. (Here a decision must be made as to capacity. The working drawing is of a 4- to 6-cup size. Adjust the size to the capacity desired keeping in mind shrinkage and wall thickness as discussed in Related Technical Information in this section.)

Transfer pattern to ⅛-inch tempered Masonite to make template.

Make two-piece drain cast mold model either on turning box or plaster wheel. (See unit, Turning Box.)

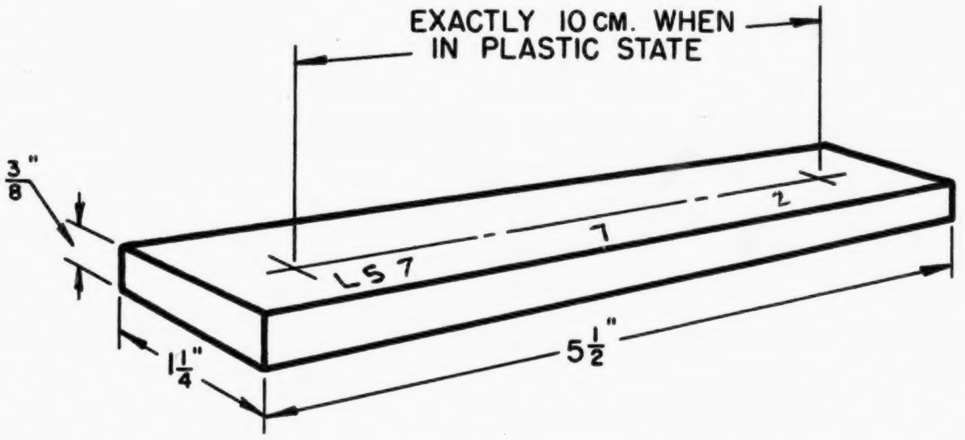
Follow usual procedure in mold making.

Related Technical Information

Wall Thickness and Clay Shrinkage:

There are two very real problems in making a mold for a clay container which is to hold a specific amount of liquid. They are the determination of the cross-section thickness of the piece to be cast and the shrinkage of the casting clay. Cross-section thickness is primarily a matter of timing for drain cast pieces. Shrinkage is affected by the composition of the clay body and firing temperature. In order to avoid a haphazard approach to the shrinkage problem, a test can be performed with any clay body. The information gained from this test can be used as a standard when comparatively accurate model work is planned.

A test tile (approximately ⅜ inch thick x 1¼ inches wide x 5½ inches long) is made from the clay being used. On this tile locate two fixed points exactly 10 centimeters apart. These are cut in with a sharp knife while the clay is plastic.



Other information can be pressed in with metal type (type of clay, personal identification, firing temperature, etc.). Allow to dry flat and fire to predetermine temperature.

Measure the fired tile and compute the percentage of shrinkage using the equation and following the examples given below:

$$\frac{\text{(Length plastic minus length fired)} \times 100}{\text{Length plastic}} = \%\ \text{of shrinkage}$$

$$\frac{10\text{-}8 \times 100}{10} = \frac{2 \times 100}{10} = 20\%\ \text{of shrinkage}$$

$$\frac{10\text{-}7.8 \times 100}{10} = \frac{2.2 \times 100}{10} = 22\%\ \text{of shrinkage}$$

To be concerned about shrinkage at first may not seem too significant, but when it is realized how much this property of clay affects volume, it becomes very important.

Other topics to explore:

The Percentage of Moisture Necessary to Make Clay Plastic
The Volume of Certain Standard Items Which Hold Liquids

Demonstrations

Determine shrinkage in a clay body.
Use pyrometric cones.

Related Cultural Information

Development of Pyrometric Cones:

One of the many ways to record temperature in kilns is by means of the pyrometric cone. It continues to be accepted as one of the most reliable, foolproof and inexpensive temperature and time indicators yet devised despite elaborate advances in electronic and optical instruments.

Quite often a kiln is equipped with several thermal checks. The pyrometric cone is one device used most often.

The pyrometric cone first appeared in France as early as 1882 at the Sevres Pottery near Paris. As soon as the potential was realized, improvements continued to be made in Europe. Men such as Lauth, Vogt, and Seger are names forever recorded by history for their contributions to ceramics. In 1887 cones were made at a pottery in Ohio. Quite soon after their introduction to America it became the self-imposed task of General Edward Orton, Jr. to initiate and finance an extensive study (which in effect still exists) directed towards the improvement of the pyrometric cone. These cones are now offered to the world at the lowest possible price in order to achieve the lifelong ambition of General Orton—that of improving the ware produced by the ceramic industry.

Another topic to explore:

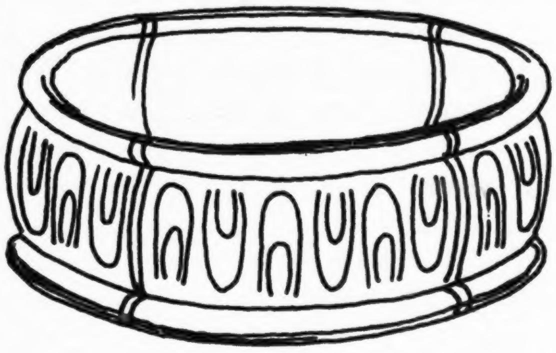
Cone Number and Temperature Equivalents

Reference

Orton Standard Pyrometric Cones, Columbus, Ohio. Edward Orton Ceramic Foundation.

EXTRUDING

BRACELET



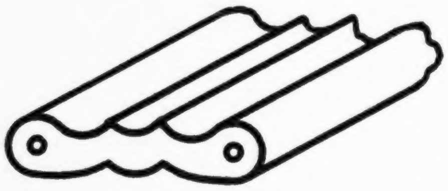
A ceramic bracelet can be a most attractive addition to a lady's costume.

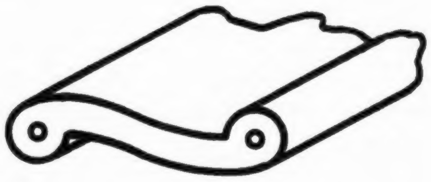
Extrusion, an unusual forming method, is used in making this project. It is possible to produce a dozen as easily as one, with endless variations.

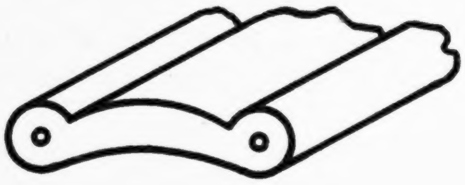
Working Drawing

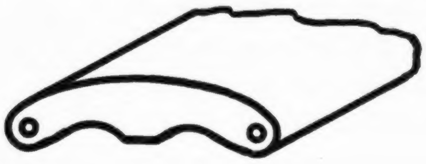
Refer to the belt or bracelet die in the unit on the extrusion press.

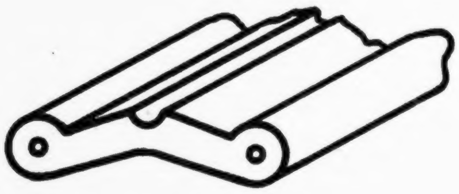
Alternate Designs

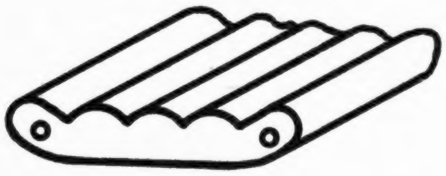












Research Activities

Try small sections of the bracelet blank, trimmed to various shapes for use as earrings and pins for a matching set.

Make a woman's belt from the bracelet blanks using very strong twine instead of elastic cord.

Alternate clay links with strips of wood or leather.

Make a die of similar design and extrude bead stock.

Experiment with a multiple strand of bead stock as a bracelet.

Mix a batch of Egyptian Paste (see Related Technical Information in this unit) and extrude bracelet or beads for self-glazing and fire jewelry.

Procedure

Make full-size profile of cross-section desired.

Cement this drawing to 16-gage brass or copper.

Cut carefully near line using drill and jeweler's saw.

Refine shape to line and round over inside corners with jeweler's file.

Drill and mount wires. (See detail in unit on extrusion press dies.)

Wedge clay to approximate throwing consistency.

Insert rope of clay in press.

Extrude shape allowing it to assume a smooth curve.

Cut into 6- or 7-inch lengths and carefully form these into 1½ inch × 2½ inch ovals, lie on edge, and allow to begin drying.

When pieces reach a soft leather-hard condition cut each into the number of segments desired. By varying the lengths of segments and by making one extra segment, the bracelet can be adjusted to size by discarding the appropriate lengthed segment.

While in this same condition emboss or carve outer surface with appropriate design.

Fettle edges and allow to dry. Bisque fire.

Apply underglaze if desired, glaze and fire (use small stilts or string on nichrome wire between two bricks).

String with elastic cord—stretch each cord slightly, knot and clip ends—pull knot inside one link.

Related Technical Information

Egyptian Paste:

Egyptian Paste represents the earliest form of glaze and is known to have been in use nearly 7,000 years ago.

The glaze-forming materials are added to Egyptian Paste in soluble form. As the formed pieces dry the water carries the soluble salts to the surface where they remain and combine in the firing with the silica and metallic oxides in the body to form exciting glazed pieces.

Following are two formulas that will yield interesting colors with the addition of approximately three percent of coloring oxides or glaze stains, copper sulphate or carbonate yielding the favorite—turquoise blue.

#1 Cone 08	
Feldspar	34
Flint	34
Clay	11
Sodium Bicarbonate	5
Sodium Carbonate	5

#2 Cone 07	
Feldspar	40
Flint	20
Kaolin	15
Ball Clay	5
Sodium Bicarbonate	6
Soda Ash	6
Whiting	5
Fine White Sand	8

(Note: both bodies will require addition of dextrine or gum to improve workability.)

Other topics to explore:

Other Ways of Making Ceramic Jewelry
Composition of One Fire Glazes

Demonstrations

Prepare clay for extrusion.
Use extrusion press.
Apply overglaze lustres.

Related Cultural Information

Early Ceramic Jewelry:

The first glazed ware was undoubtedly made by the early Egyptians using the various forms of soda which occur in the desert lands of that part of the world.

Some of the first glazed jewelry was in the form of quartz pebbles covered with a copper-bearing soda-glaze—yielding a beautiful transparent blue.

In most parts of the world potters fashion not only utensils but articles for personal adornment as well as symbolic figures or totems. These, of course, have withstood the effects of time and are with us today as a highly informative page out of the dim past telling us much of long-forgotten cultures.

Ceramic jewelry has increased in popularity in recent times especially since the metal-scarce period of World War II. With the growing knowledge and appreciation of ceramics, this type of jewelry will certainly remain in demand.

Another topic to explore:

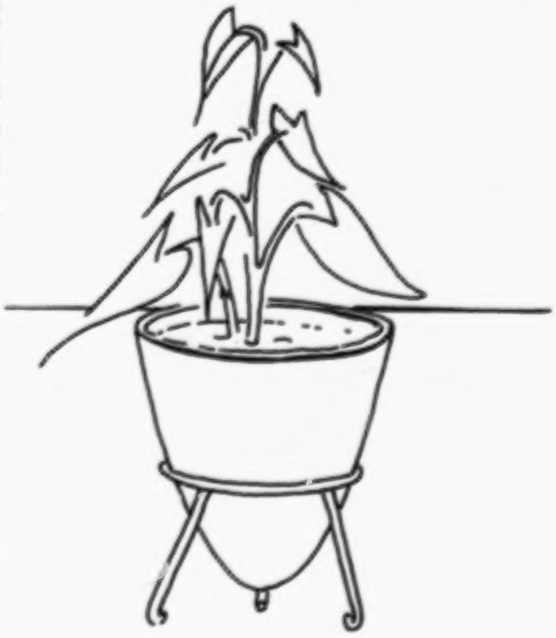
Forms of Antique Ceramic Jewelry

Reference

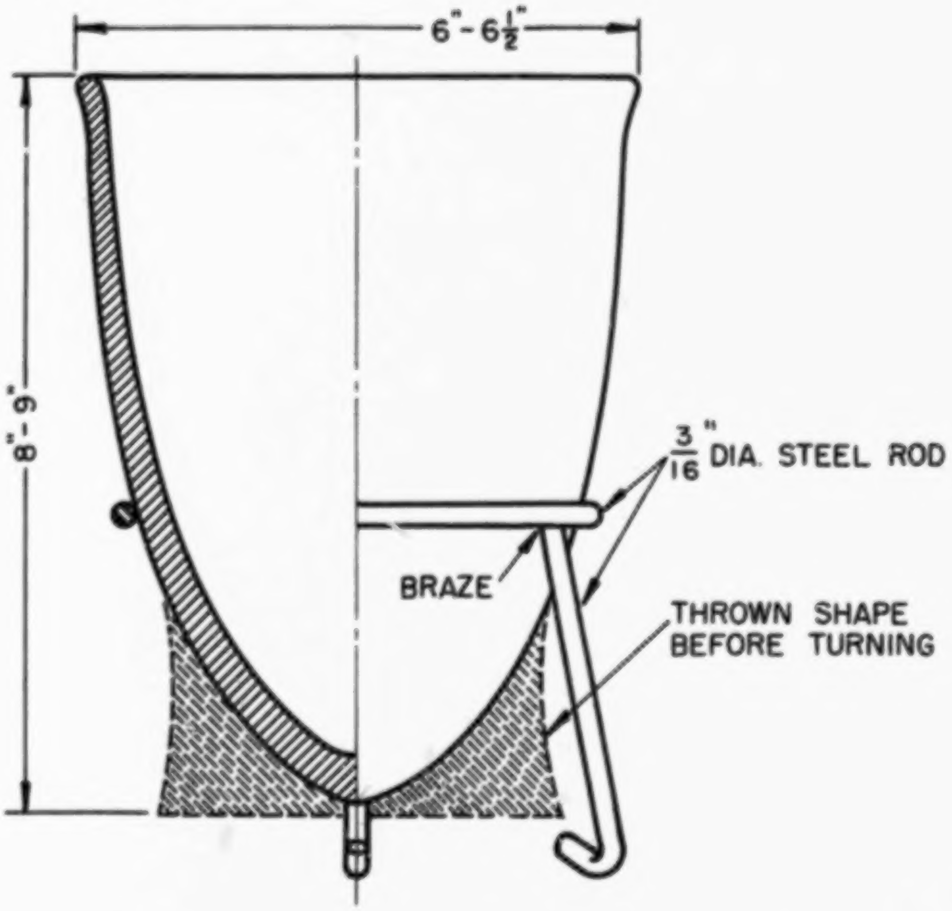
Rhodes, Daniel. *Clay and Glazes for the Potter*. pp. 190-191

PLANTER

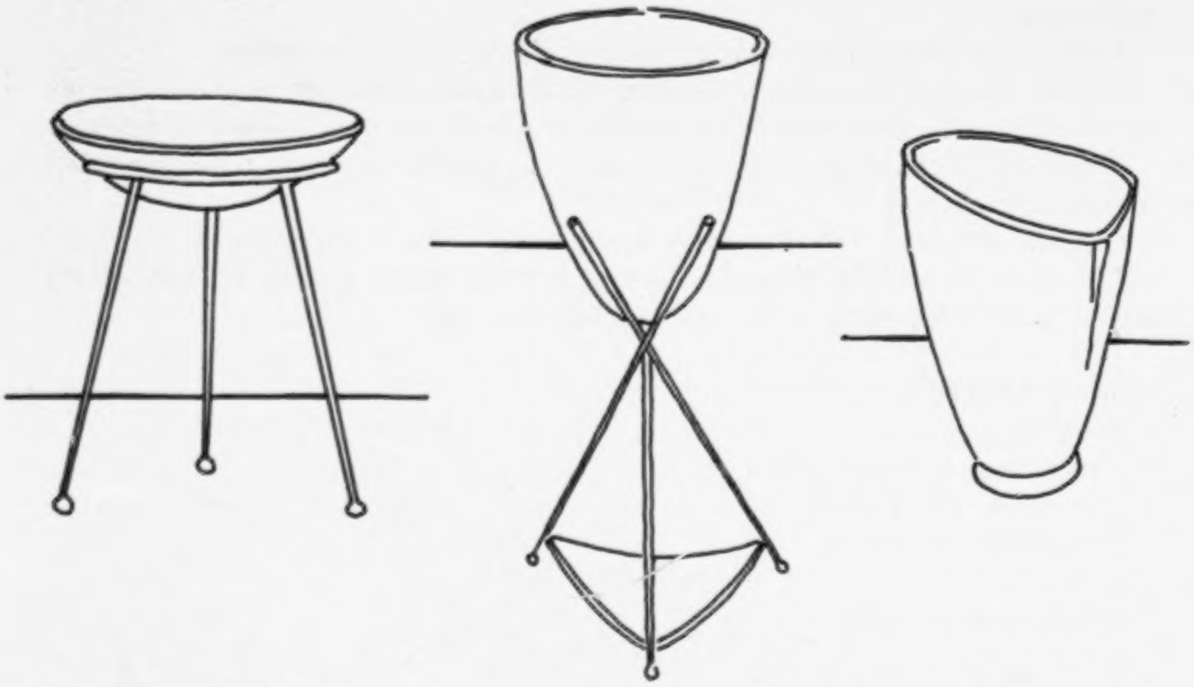
The increasing use of large exotic-leafed plants as a part of the interior decoration scheme for houses and offices makes the use of a well-designed container of the proper size and height a necessity. Metal is combined with ceramic material in this. It can be thrown by a beginner.



Working Drawing


6"-6½"
8"-9"
3/16" DIA. STEEL ROD
BRAZE
THROWN SHAPE BEFORE TURNING

Alternate Designs



Research Activities

Investigate different base possibilities using soft wire for three-dimensional "sketches."

Design pots for specific plants, relating shape and volume to the requirements of the plant.

Ask plant or flower fanciers about the kind of pot best suited for plants—bisque or glaze finish.

Design a planter to fit a particular window sill or shelf.

Procedure

Design basic clay shape and metal base, full size.

Wedge sufficient clay.

Throw pot to height and diameter and set aside until leather hard.

Fabricate metal base, paint flat black.

Invert leather-hard pot on wheel head, turn to shape, and effect surface decoration if desired.

Allow pot to dry thoroughly and bisque fire.

Glaze and fire.

Fit pot to base.

Related Technical Information

Throwing Helps:

The following suggestions will help to improve your performance on the potter's wheel:

Clay should be thoroughly wedged; uneven texture and air bubbles make throwing difficult to impossible.

The addition of fine grog will usually improve the throwing quality and make possible taller pots.

Always keep hands wet. Wet inner and outer surfaces of pot to keep drag or friction to a minimum.

Throw with the whole body rather than hands and forearms alone. This is especially important in centering when considerable downward force is necessary.

Always release pressure on the clay gradually (from the shoulders down) to avoid wobbly pots.

True rim of piece as throwing progresses by trimming if necessary.

Reduce speed of the potter's wheel as the diameter of the pot increases. Do not add the effect of centrifugal force to that of gravity on pots nearing completion.

Try to keep both hands connected by touching thumbs or fingers while centering, raising, and shaping.

On kick wheels do not kick while hands are in contact with the clay.

Cut away excess clay from the foot of a piece before putting it away to dry leather hard. This helps to prevent cracked bottoms.

Demonstrations

Wedge clay.
Center clay on potter's wheel.
Throw on potter's wheel.
Turn leather-hard ware.
Trim a foot.
Cut piece from wheel.

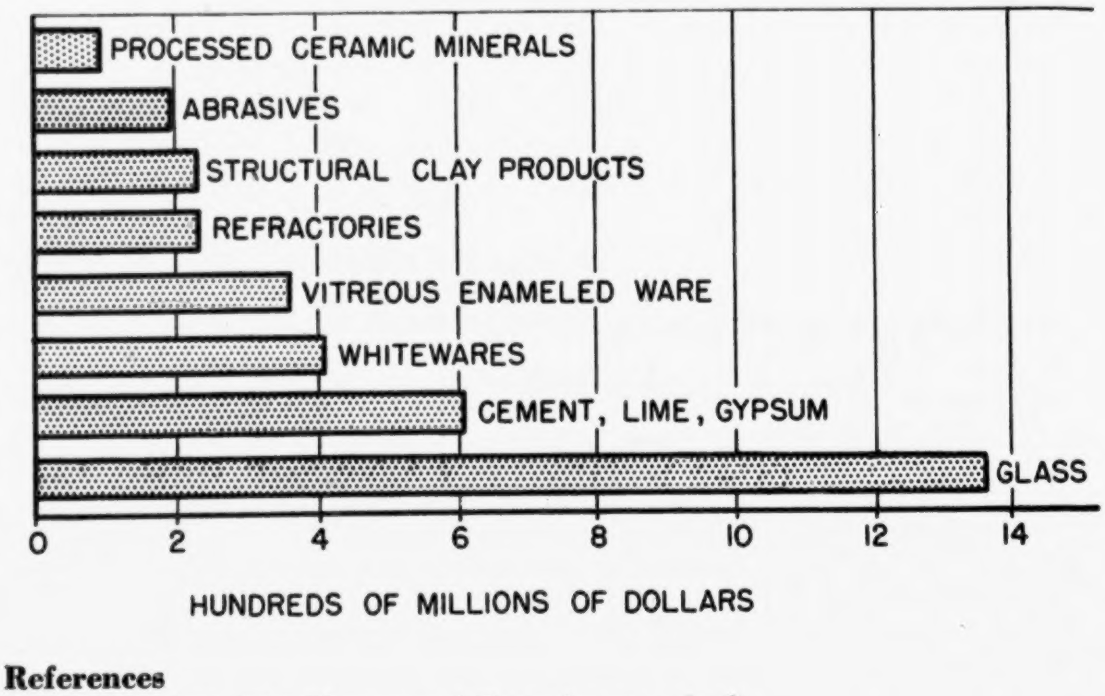
Related Cultural Information

Scope of the Ceramic Industry:

The chart below will give the reader an overview of the scope of the ceramics industry and an interesting comparison of the dollar volume of its many branches.

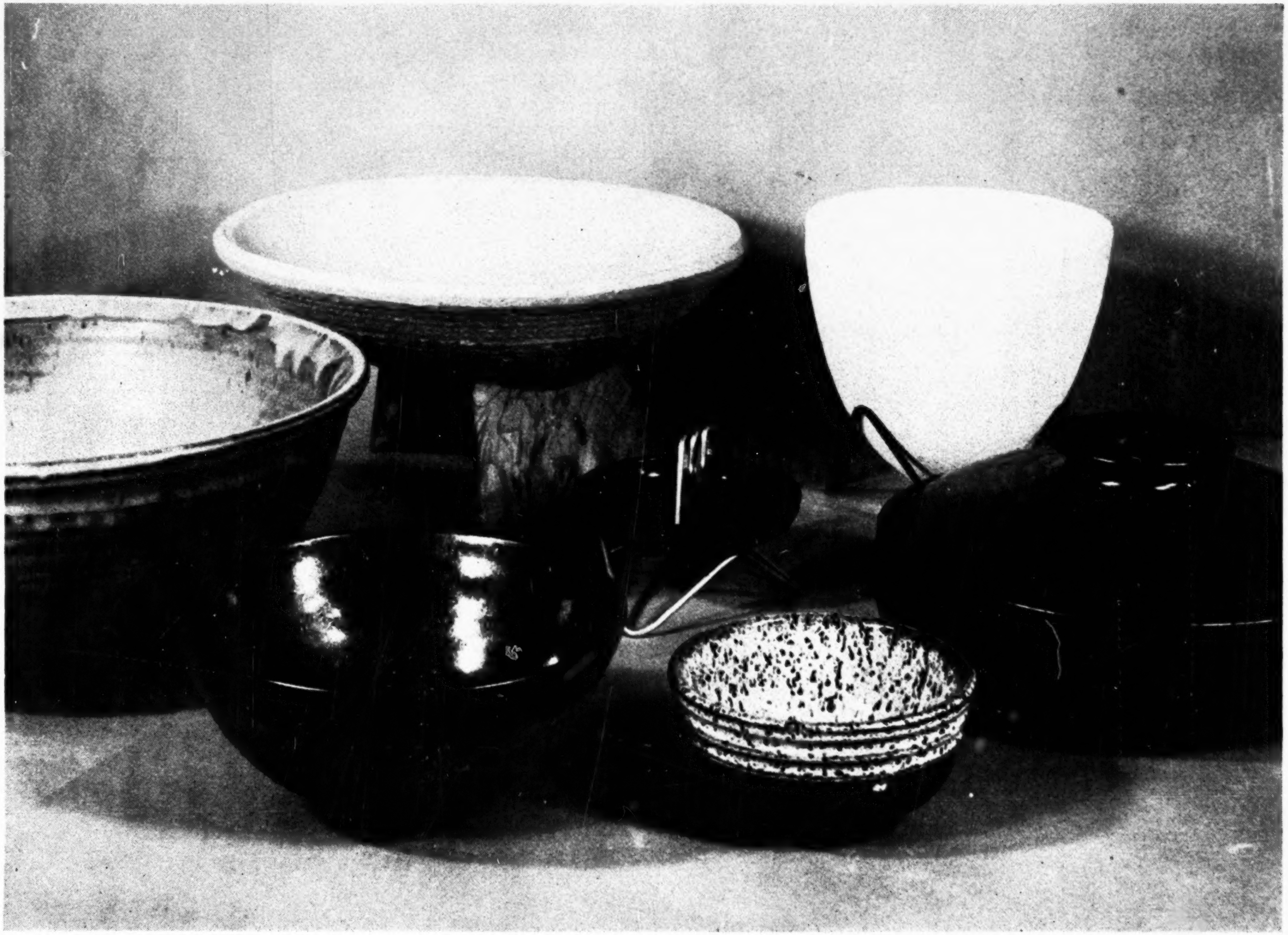
While we are more or less familiar with the ceramic materials that surround us in our daily lives, it is important that we notice that the bulk of the products of ceramic industries are used by other industries as raw materials, tools, or equipment for production.

It is interesting to note that chinaware and pottery which we commonly think of when we hear the term "ceramics" occupies only a part of one of the smaller categories (whitewares) on this chart.



References

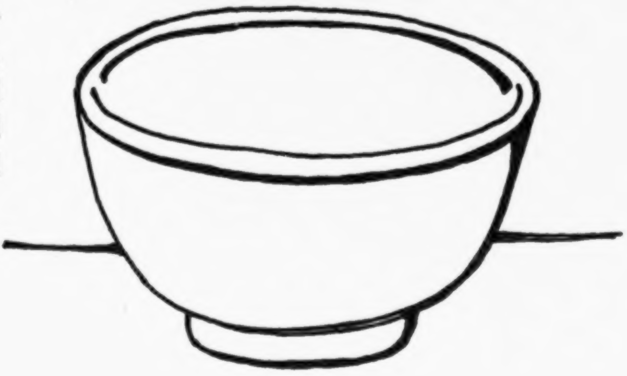
Norton, F. H. *The Elements of Ceramics.* pp. xi, xiv
Olson, D. W. *Pottery.* Chapter 8



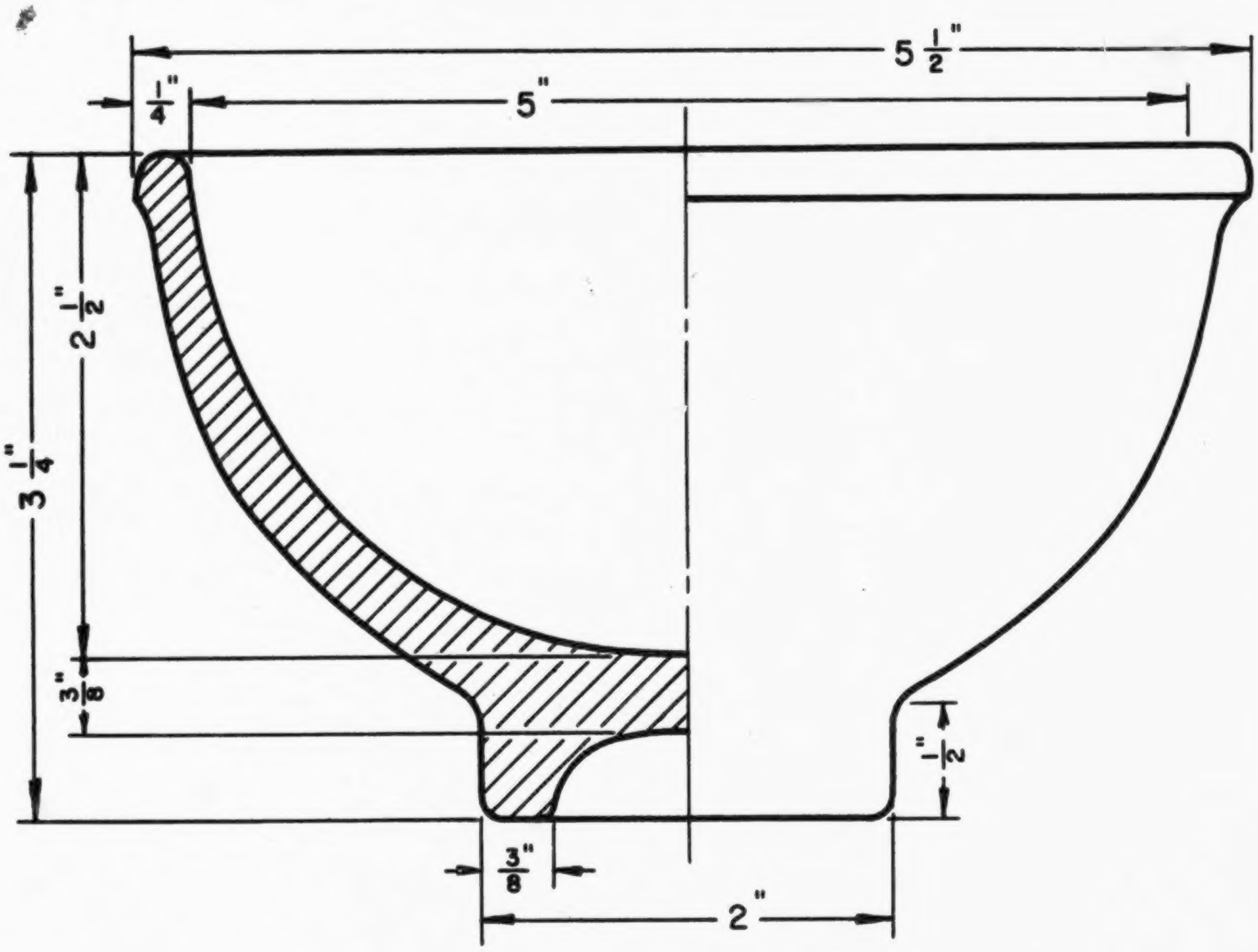
Pieces involving throwing and turning.

BOWLS

A ceramic bowl will prove to be a challenging project that has many uses. Throwing a bowl on the potter's wheel provides an opportunity to design and make a ceramic piece of the size and shape for a particular use.

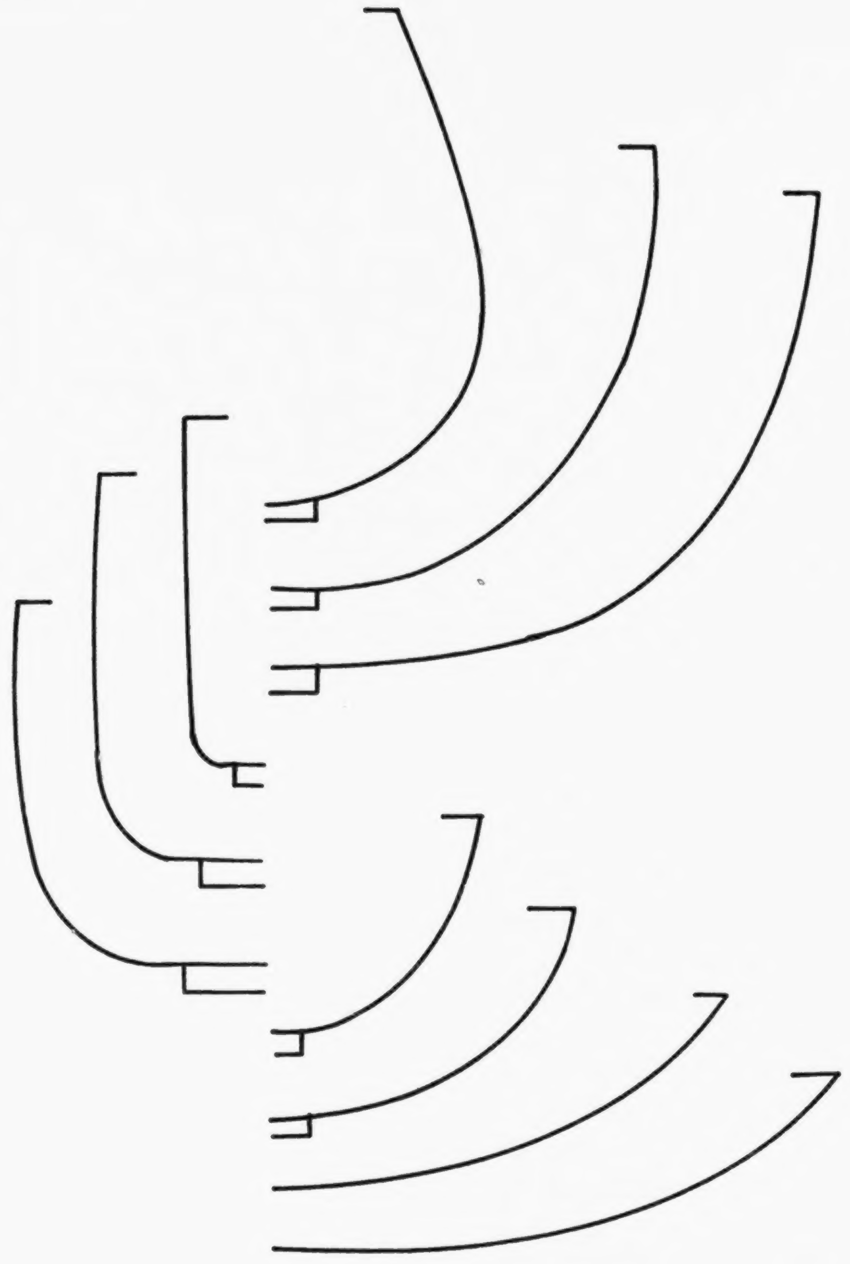


Working Drawing



(ALL DIMENSIONS ARE APPROXIMATE)

Alternate Designs



Research Activities

Investigate the size requirements of bowls that have special purposes (wash basin, mixing, cereal, soup, etc.).

Design a nesting set of bowls at full scale.

Procedure

Wedge enough clay for the bowl to be made.

Center clay on wheel.

When opening centered clay allow plenty of room for turned foot. (More than enough clay for the foot is preferred rather than too little.)

Finish throwing. (See *Ceramics for the Artist Potter,* pp. 25-29.)

Allow pot to become leather hard.

Turn pot on rim and recenter on a clean bat.

Lock pot into centered position by pressing 3 or 4 plastic lumps of clay onto bat at the base of the rim. (See figure 1.)

Turn foot as desired. For useful tool see section in Appendix on hand tools.

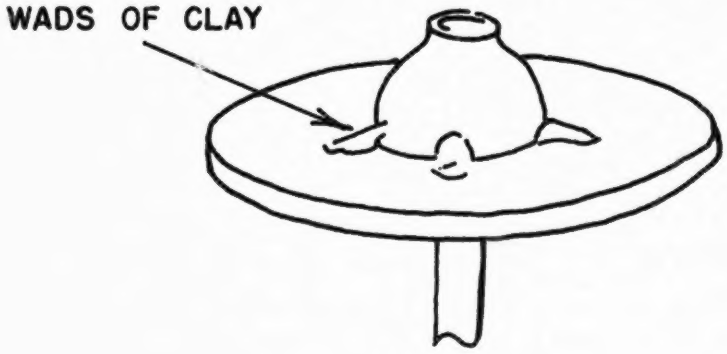


FIGURE 1.

Related Technical Information

Bowl Structure:

There are many logical reasons for the change in cross-section on any wheel-thrown piece of pottery. In order to promote progress it is well to be informed and become aware of these facts very early in anyone's wheel-throwing experience. Careful observation of specially designed profiles and cross-sections (as shown in the alternate designs) enables a potter to develop an awareness of good structural treatment that he should strive to incorporate in his pots.

Other topics to explore:

Procedure for Trimming a Foot
Technique of Trimming
Hand Positions to Produce Rim on Piece

Demonstrations

Center a leather-hard cup.
Lock a leather-hard cup on the wheel head.
Turn a foot on a leather-hard bowl.

Related Cultural Information

Use Affects Design:

Oriental habits of eating have made the people of China and Japan very sensitive to many ceramic problems. Their practice of using chopsticks and using cup-like bowls without handles over hundreds of years have made them acutely aware of bowl forms. There is a very practical reason for having a deep foot on a drinking bowl without a handle. By actually handling and seeing bowl forms so often and for so long the oriental cultures have arrived at some very valid solutions that we, with less tradition and entirely different habits, will find to be very interesting.

Other topics to explore:

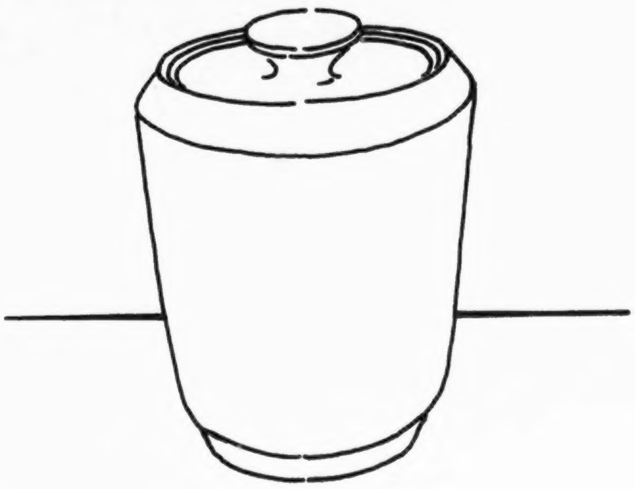
Oriental Eating Practices
The Type of Ceramics Preferred by an Oriental Gourmet

References

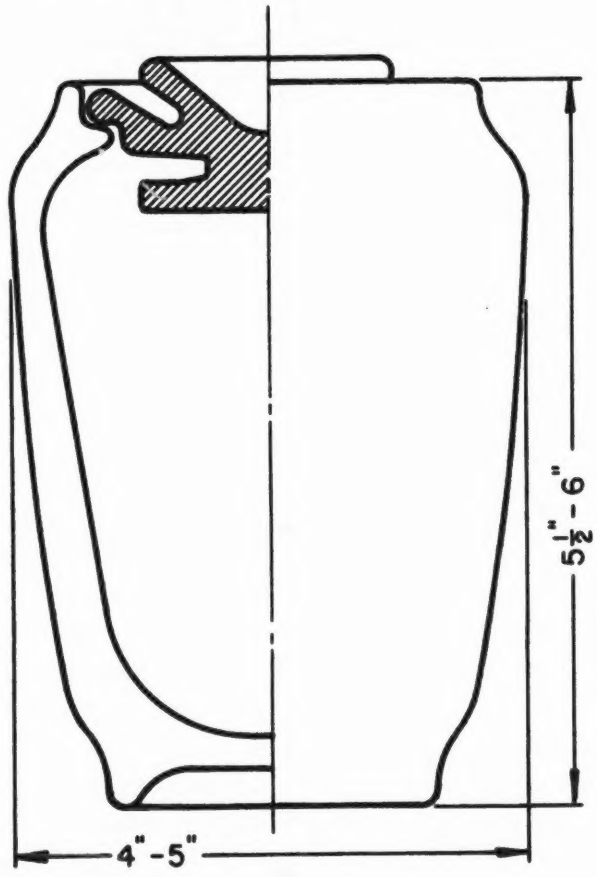
Leach, B. A. *Potter's Book*. pp. 7-12
Norton, F. H. *Ceramics for the Artist Potter*. pp. 25-29

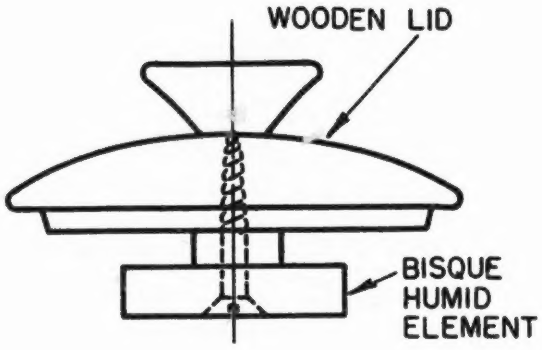
TOBACCO HUMIDOR

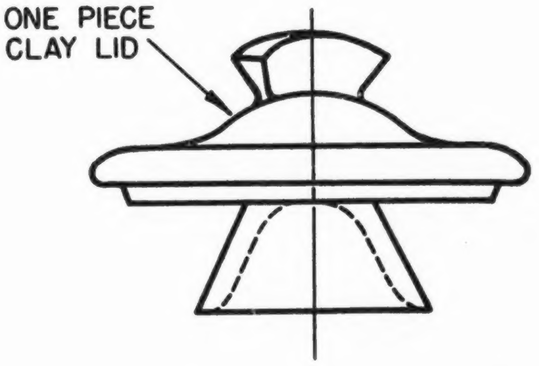
An attractive and colorful humidor to hold pipe tobacco or cigars to keep the contents in good condition is a welcome gift to the smoker. The built-in humidifying element is an added feature of this project.



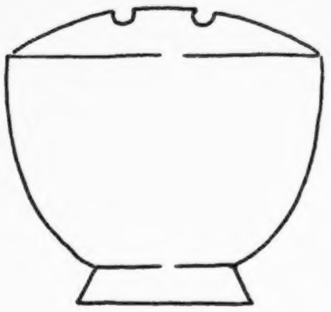
Working Drawing

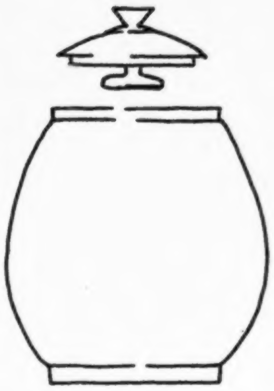


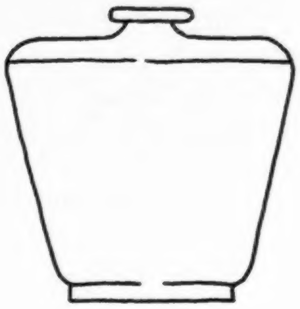

WOODEN LID
BISQUE HUMID ELEMENT

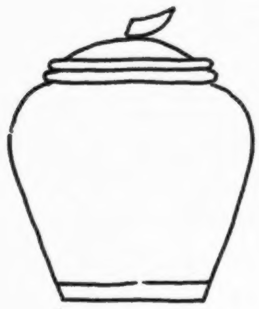

ONE PIECE CLAY LID

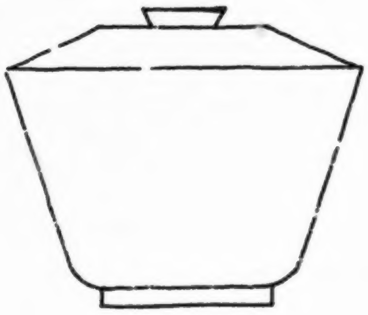
Alternate Designs

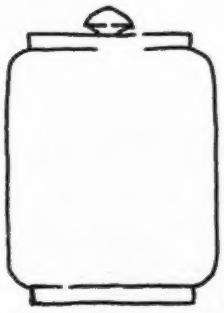


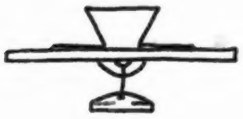


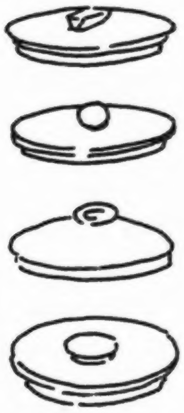












Research Activities

Sketch other shapes and select the one that will best fit its intended use.

Develop a shape suitable for a set such as spice canisters or jam jars and make a rib to serve as a template to aid in throwing several pieces of uniform size and shape.

Experiment with different materials for a cover, such as a rich dark hardwood, or either spun or raised metal.

Secure a container and design a clay shape into which the metal can may be placed.

Design a similar humidor for the storing of cigars.

Experiment with different types of materials to serve as humidifying elements. Devise means of attaching them to the lid.

Procedure

Develop and design a full-size profile drawing of piece.

Prepare sufficient quantity of clay and wedge thoroughly.

Throw jar, checking final size and shape with calipers or template.

Set piece aside to dry partially.

Measure and record neck and shelf diameters of jar in green state. (See figure 1.)

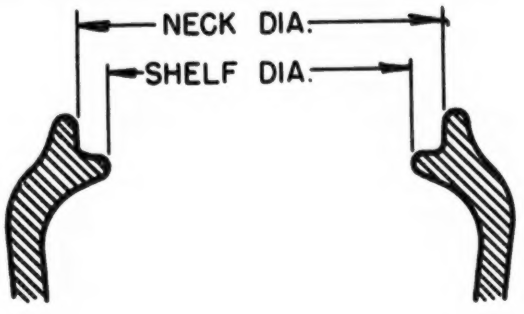


FIGURE 1

Throw lid and handle in upright position, check outside diameter carefully and allow pieces to dry leather hard.

Center inverted jar on wheel and turn foot. Trim outer surface if desired and shape rim for lid as necessary. (See *The Potter's Craft,* pp. 105-106.)

Center leather-hard lid on wheel bottom side up and turn inside of lid to fit humidifier element, and edge to fit jar rim.

Check fit of lid, allowing clearance for glaze thickness.

Dry jar with lid in place and fire in same condition.

Apply glaze, leaving whole bottom of lid bare to absorb moisture and serve as humidifying element.

Gloss fire.

Related Technical Information

Accurate Turning of Clay:

Some fine ceramic ware, after forming, in what is called the leather-hard stage, is placed in a chuck or a lathe or on a potter's wheel and turned to exact dimensions with steel tools. The feet on most thrown ware are turned in this manner.

The eggshell porcelain of the Chinese was made by turning from heavier thrown pieces. This method was also used by the Ancient Greeks to form their exquisite vases. Industrially this method is used today to produce the high-tension electrical insulators both large and small. These are produced by casting or pressing the blanks and after drying shrinkage has taken place, they are then turned to very precise shapes on lathes designed for this purpose. In pottery too, the advantage of this method lies in the relative precision obtainable since warpage and shrinkage have already taken place before the turning operation.

One of the best sources of information on turning is: *The Potter's Craft,* p. 10.

Other topics to explore:

- Tools Used to Turn Clay in Leather-Hard State
- Chucks and Chums for Turning

Demonstrations

Wedge clay for turning.

Throw a lid.

Turn a foot.

Make and fit a lid.

Related Cultural Information

The Potter's Wheel:

The exact time and place of the invention of the potter's wheel is not known. It is generally accepted that it was in use in the Near East at least 5,000 years ago.

Evidence shows that the potter's wheel was used in most of the great cultures of the past—Egyptian, Greek, and Chinese—although it may or may not have been an independent discovery in each country. It is generally accepted, too, that it is the ancestor of the lathe as we know it and in fact, of all uses of the wheel and axle.

The potter's wheel has changed little in its descent through the ages. Basically it still usually consists of a head or working surface fastened to an upright shaft over a heavy flywheel. The potter either kicks the flywheel or presses a treadle attached to it through an eccentric. Many electric models are now available with a great variety of speed-controlling mechanisms.

Other topics to explore:

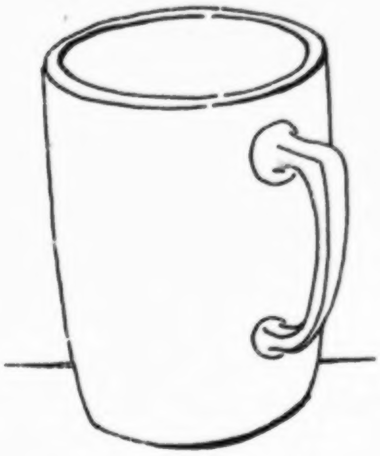
History as Read Through Pottery
Potter's Wheels You Could Construct
Mechanical Principles Employed in the Potter's Wheel

References

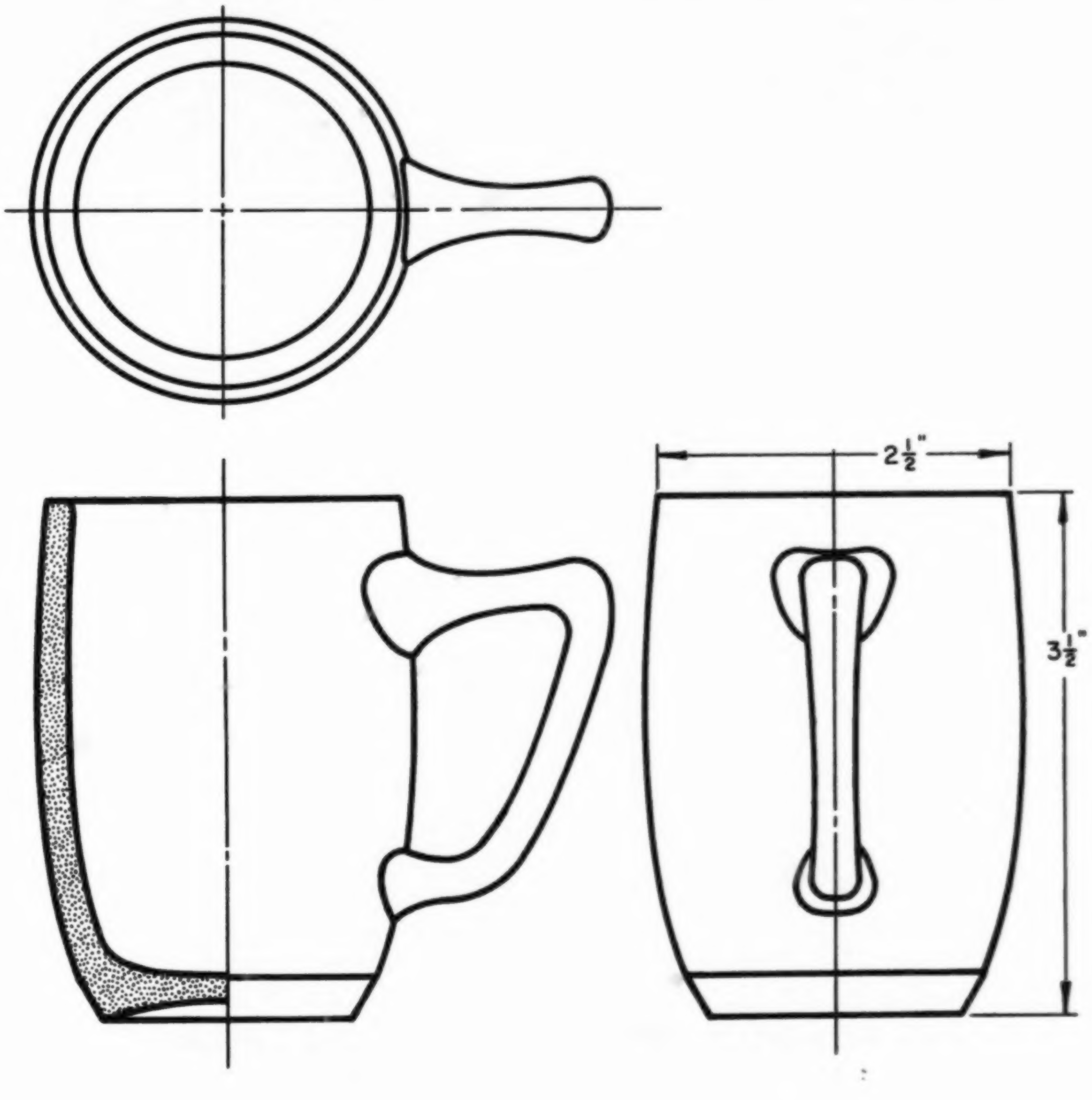
Binns, C. F. *The Potter's Craft.* Chapters 9, 10
Norton, F. H. *The Elements of Ceramics.* pp. xii-xiii, 104

MUGS AND CUPS

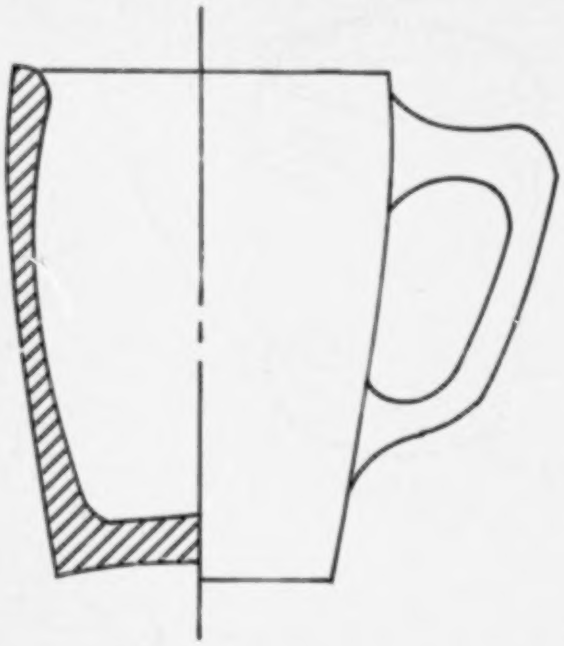
An individual drinking mug is an item that can be used every day. This is an ideal beginning project for wheel throwing. Mugs can also be made in sets.

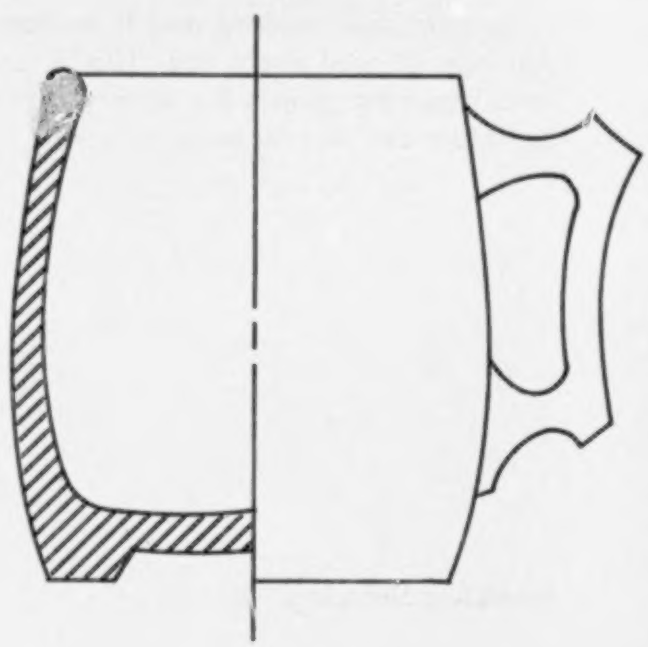


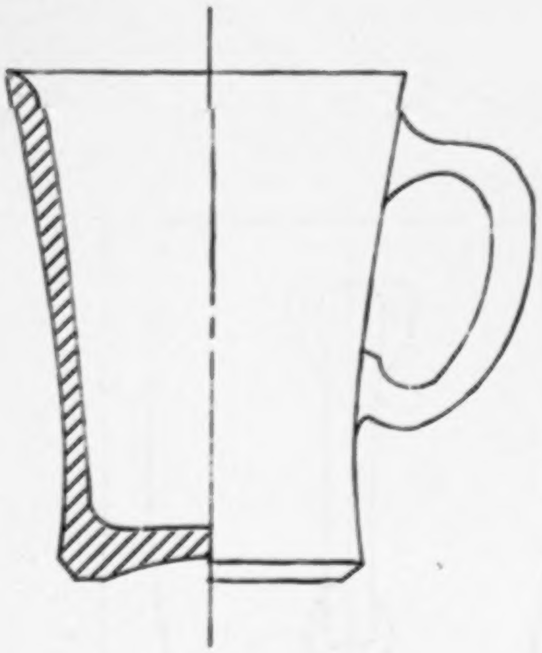
Working Drawing

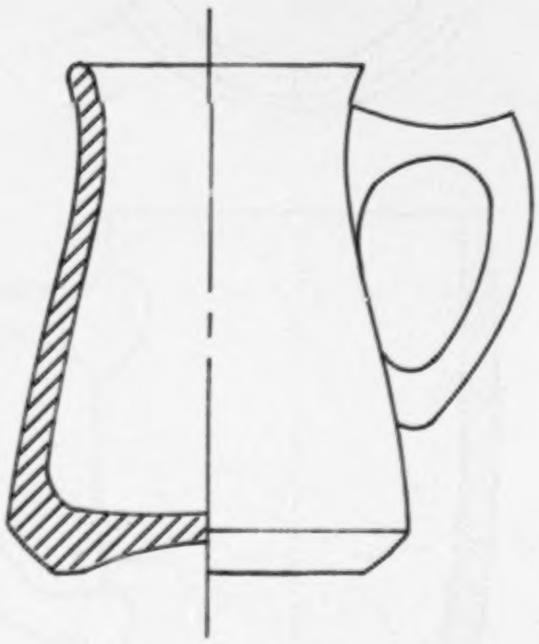


Alternate Designs









Research Activities

Observe the difference between a tea cup and a mug for hot chocolate.

Try drinking a hot liquid from a cup without a handle.

Sketch several simple decorative designs which might be applied on the potter's wheel.

Procedure

Plan the shape of mug and keep before you.
Center clay on wheel.
Throw mug using standard procedure. (See *Sunset Ceramics Book,* pp. 72-74.)
Trim finished piece if necessary.
Remove piece from wheel.
Pull handle and attach. (See *Sunset Ceramics Book,* pp. 78-79.)
Allow to dry leather hard.
Finish by fettling with sponge.
Bisque fire.
Decorate with underglaze if desired.
Glaze.
Note: Slip decoration or texturing may be added before removing from the wheel.

Related Technical Information

Mixing Throwing Clay:

Practically every clay is capable of being thrown to a certain degree. With very little experience, however, it soon becomes apparent that one clay will prove superior to another when it is intended for serious work on the potter's wheel. Many prepared clays are unsatisfactory and certainly were not compounded with throwing in mind. We could not make a good bowl out of white pine or good stair treads out of balsa wood. We would be just as mistaken to expect every clay body to work well on the potter's wheel. Too much plasticity may be overcome by adding a coarse clay or grog to the clay. Five to ten percent addition of 60- to 80-mesh grog usually helps to improve the quality of the clay for the beginner when the clay is too slick and has a tendency to slump under its own weight. Only research, experimentation, and experience will provide the information necessary for good results. As an experiment, compound the following batches and try out their throwing qualities after the clay has aged for at least a week.

1	
A very plastic red clay	100%

2	
Plastic red clay	90%
60-mesh grog	10%

3	
Plastic red clay	85%
xx sagger	10%
grog	5%

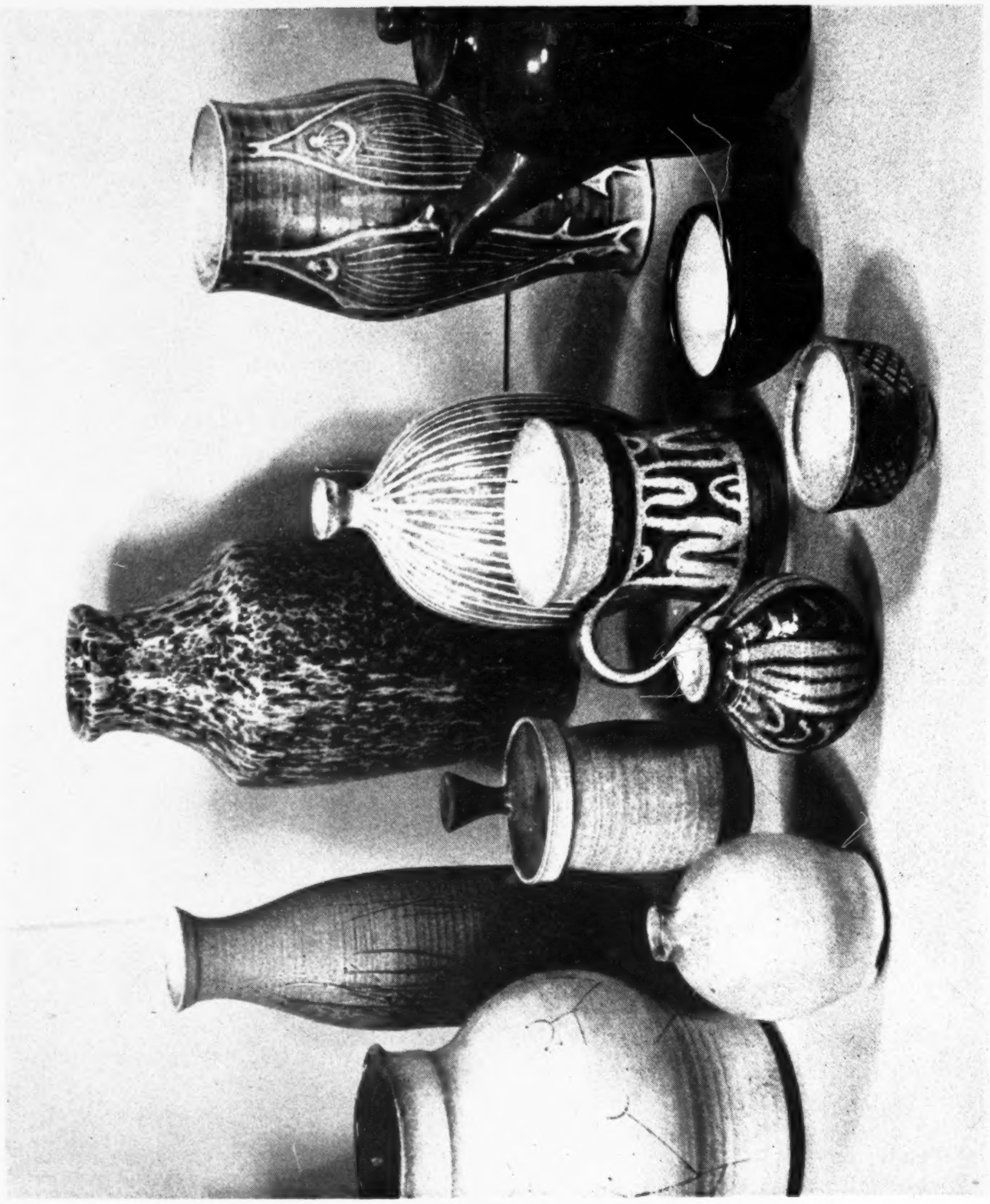
4	
Plastic red clay	75%
xx sagger	5%
grog	15%
talc	5%

Other topics to explore:

The Composition of Clay for Bricks
The Composition of Clay for Porcelain

Demonstrations

Prepare clay for throwing.
Center clay on potter's wheel.
Open and raise a cylinder.
Remove a piece from the wheel.
Pull a handle.
Attach a handle.



Thrown mugs, vases, bowls, and pots.

Related Cultural Information

Use of Kaoline:

It is very interesting to note that it is not the ceramic industry that uses the most kaoline in the United States. One would assume that kaoline (or china clay) would have more application in the ceramic industry rather than the publishing industry. Publications from the Bureau of Mines record that every year far more kaoline is consumed for paper filler and paper coating than is used by concerns manufacturing pottery tiles and refractories combined.

Other topics to explore:

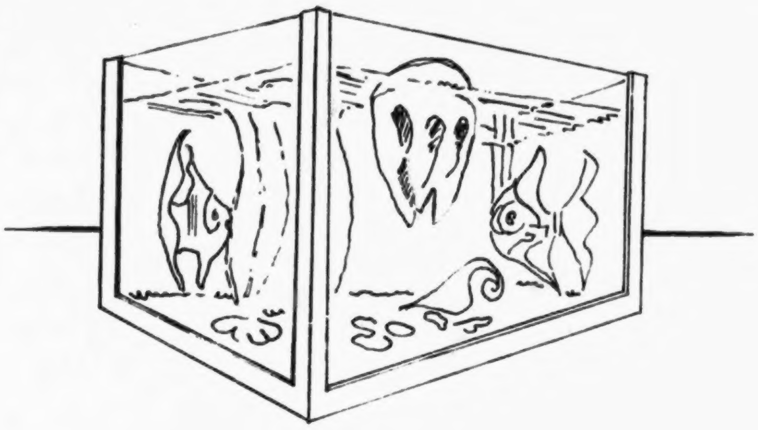
The Use of Ceramic Materials in Your Own Home and City
The Closest Ceramic Material Producing Concern in Your Area

References

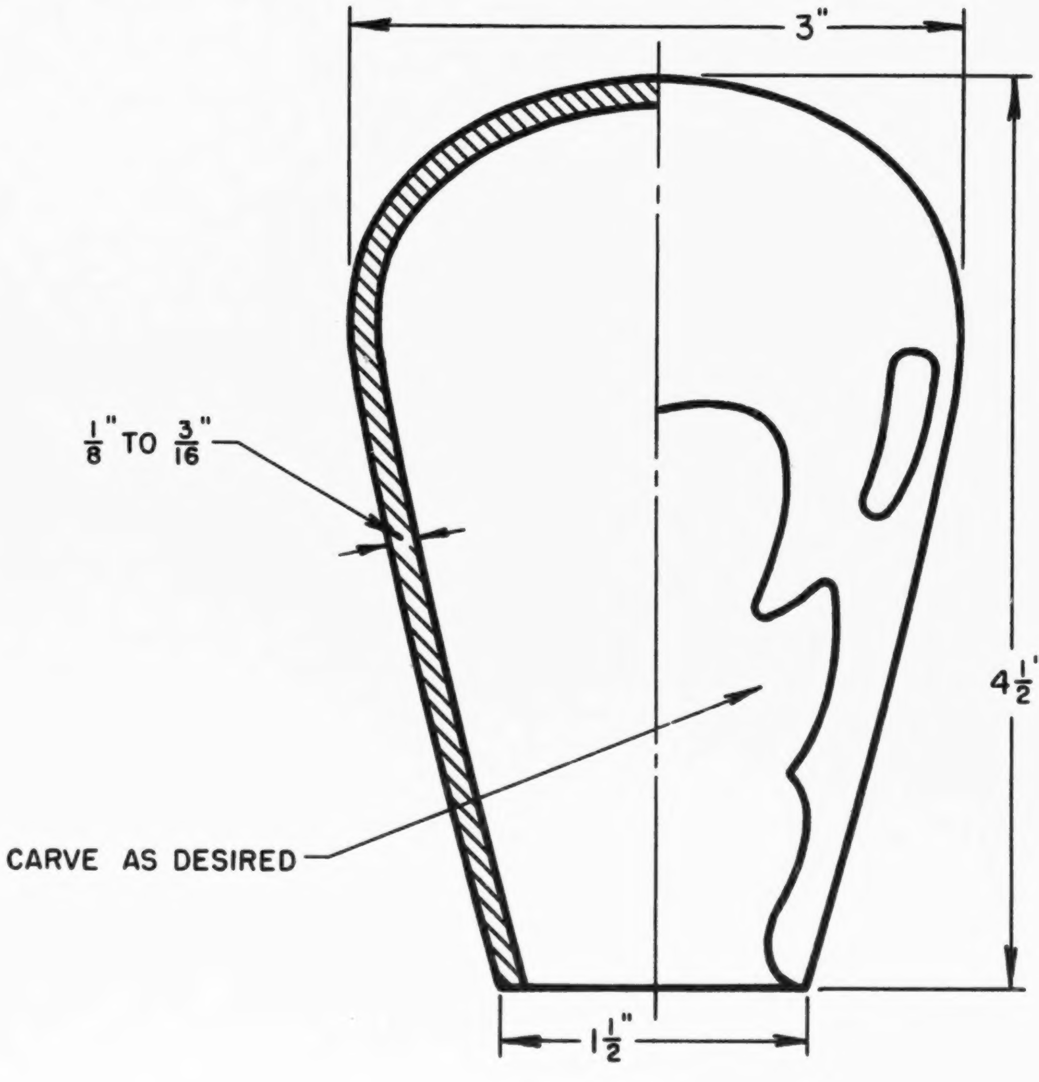
Gunsallus, B. L. *Clays*. Bureau of Mines Bulletin #556. p. 7
Rhodes, Daniel. *Clay and Glazes for the Potter*. pp. 27-28
Sanders, H. H. *Sunset Ceramics Book*. pp. 70-84

AQUARIUM PIECE

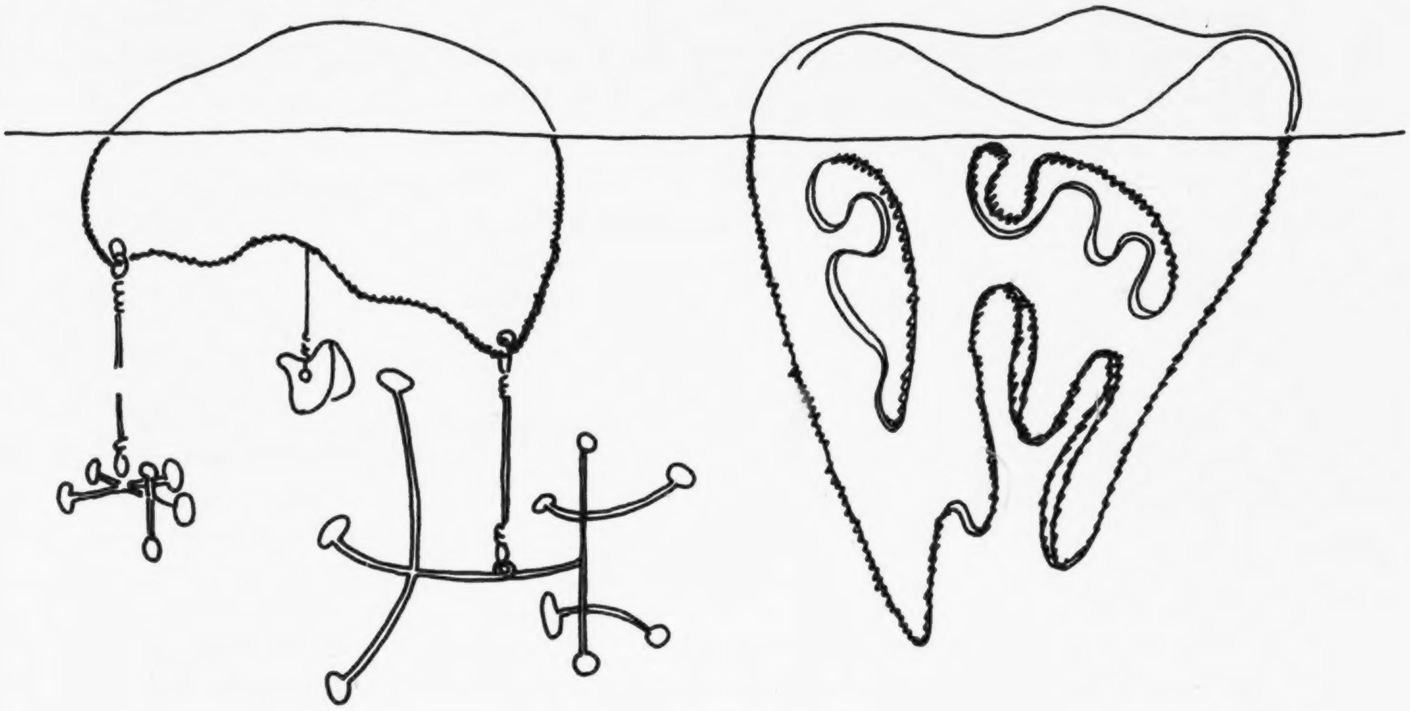
Here is an intriguing project that is somewhat novel. A small pocket of trapped air enables an interesting structure to float rather than rest on the bottom of the home aquarium.



Working Drawing


3"
$\frac{1}{8}$" TO $\frac{3}{16}$"
$4\frac{1}{2}$"
CARVE AS DESIRED
$1\frac{1}{2}$"

Alternate Designs



Research Activities

Consult with your science teacher about the Cartesian diver.

Investigate displacement problems of ship and submarine builders.

Other topics to explore:

Specific Gravity
Contributions of Archimedes

Procedure

Throw a cylinder about three times higher than its base diameter. Taper the side walls and form the hemisphere portion as indicated in the working drawing. (If it is more convenient to form this basic shape by another method it is recommended that you do so. Coil, slab, drain mold, etc.)

Allow piece to become leather hard.

Trim away all excess weight by turning or direct carving. (Try for a shell ⅛ inch to $\frac{3}{16}$ inch in thickness.)

The design of the eroded portions will be up to the students. The piece, of course, will float in the position indicated by the working drawing. It may be best to work directly on the piece. Think of it as floating and in no need of a base. Exercise care in cutting as it is quite susceptible to breakage at this stage.

Allow approximately one-third of the volume of the piece to remain trapped when the piece is inverted in water.

Allow piece to dry.

Bisque—glaze.

Adjust the air and water level until proper effect is obtained.

Related Technical Information

Buoyancy:

It becomes an interesting problem to figure out whether or not an object will float. The simplest way, of course, would be to throw it into water and observe the results. This very direct manner, however, is impossible with a ship or submarine. In order to indicate how to calculate the buoyancy of the piece the following example is given:

A cubic foot of fresh water weighs 62.4 lbs. A cubic foot contains 1,728 cubic inches, hence a cubic inch of water will weigh .577 ounces.

62.4 weight of water per cubic foot
x 16 oz. per lb.
3744
624
998.4 oz. per cubic foot

.577 oz. per cubic inch
1,728) 998.40
864.0
13440
12096
1344

Knowing that the weight of a cubic inch of water is approximately .577 ounces we can calculate the approximate buoyancy advantage of an object by figuring out its trapped air volume and multiplying it by this figure. The object is then weighed to determine if its displacement will be overcome by the buoyancy figure and thereby predict if it will float. Using this information as a guide it is possible to carve a shape to fulfill the practical need while still leather hard.

This can only be a rough approximation because the clay will give off moisture and weight during the drying and firing. The trapped air chamber will shrink and the object take on the additional weight of the glaze. Even assuming that these factors will cancel each other out we should allow a fair margin of safety because one of the most obvious ways to adjust the buoyancy is by raising or lowering the water level.

It would, however, be impractical to increase the buoyancy once the object becomes fired unless some object, such as a ping pong ball, is used to overcome a miscalculation.

The aquarium piece pictured here would be calculated as follows:

Volume of a sphere = $4/3\pi r^3$

Volume of a hemisphere = $\frac{4/3\pi r^3}{2}$

Buoyant volume = $\frac{4 \times 22 \times 8}{3 \times 7 \times 2} =$

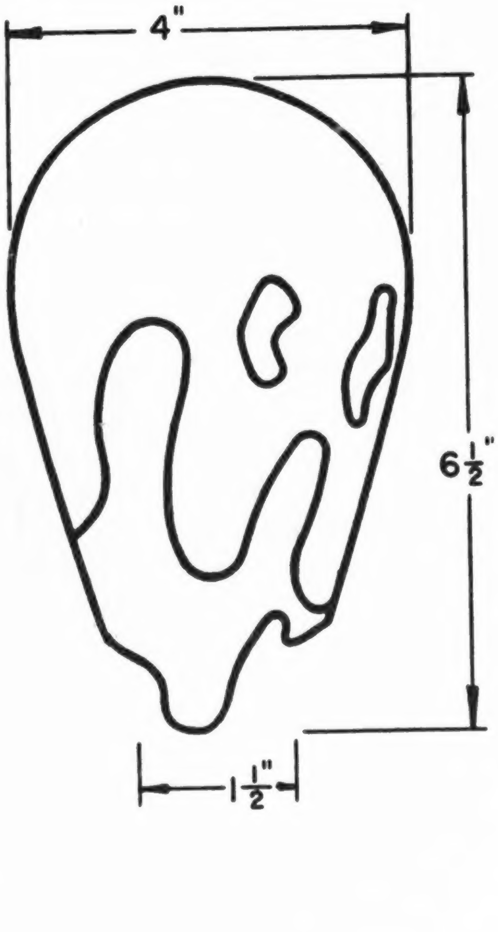
16.76 (16.8) cubic inches of trapped space.

A body totally or partially immersed in a fluid is buoyed up with a force equal to the weight of fluid displaced.

The project will sink until its weight displaces an equal amount of water.

Water weighs approximately .577 ounces per cubic inch.

16.8
.577
1176
1176
840
9.6936 = 9.7 ounces



The total weight of the finished project must be less than this figure in order to float.

One practical method of approximating the volume of a complex structure is to use dry sand and a graduated beaker.

Other topics to explore:

Why Solid Steel Floats on Mercury

The Effect of Salt Water as Compared to Fresh Water in Relation to Floating Objects.

Related Technical Information

Specific Gravity and Buoyancy:

The specific gravity of a material indicates how its density compares with the density of water. Density may be thought of as simply the weight of a standard volume of a material. Therefore, the problem becomes one of weighing a certain body and then comparing this to the weight of an equal volume of water.

To find the specific gravity of an object that is heavier than water the following procedure is followed:

1. Weigh the object in the open air.
2. Weigh the object while it is suspended in water. (The apparent loss of weight is known as the effect of buoyancy.)
3. Subtract the weight in water from the weight in air. The result is the weight of water displaced.
4. Divide the weight of the substance in air by its loss of weight in water and the result will be the specific gravity of that substance.

For example: the object weighs 15 pounds in air and 12 pounds in water. Therefore:

$$\text{Specific gravity} = \frac{\text{weight of body}}{\text{weight of water displaced}}$$

$$\text{Specific gravity} = \frac{15}{3} = 5$$

Other topics to explore:

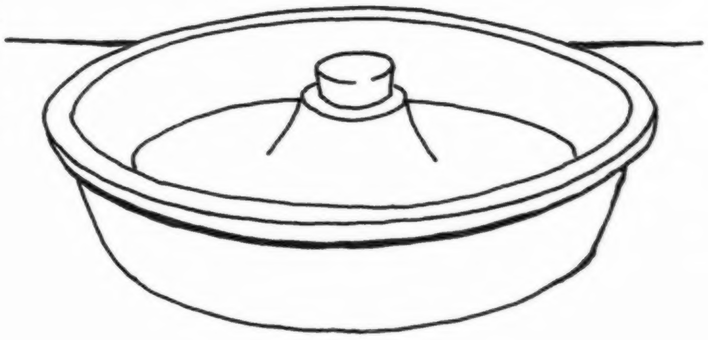
The Specific Gravity of Objects Lighter Than Water
The Specific Gravity of Liquids

Reference

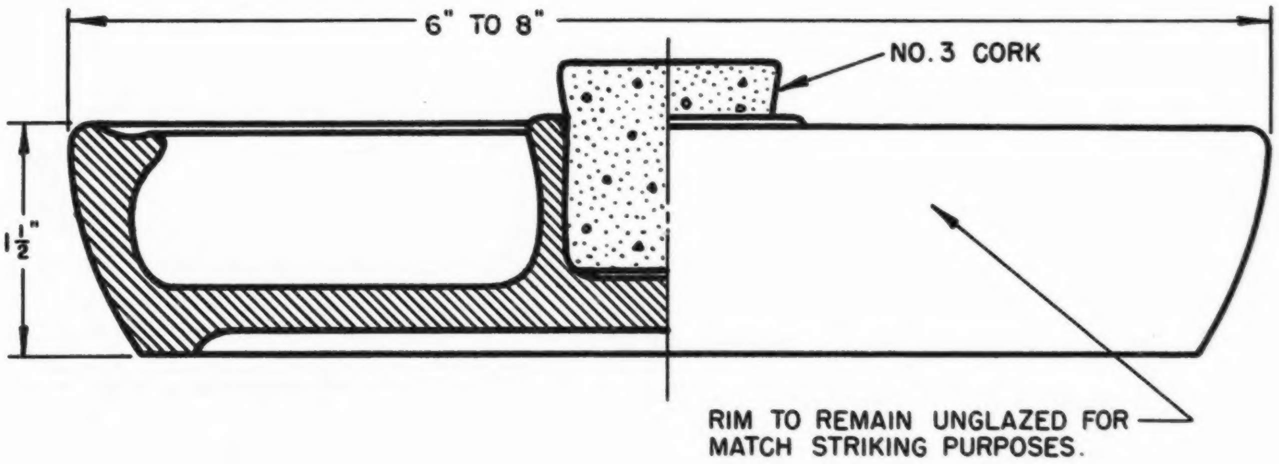
World Book Encyclopedia. pp. 368, 3,128-3,130

PIPE SMOKER'S ASHTRAY

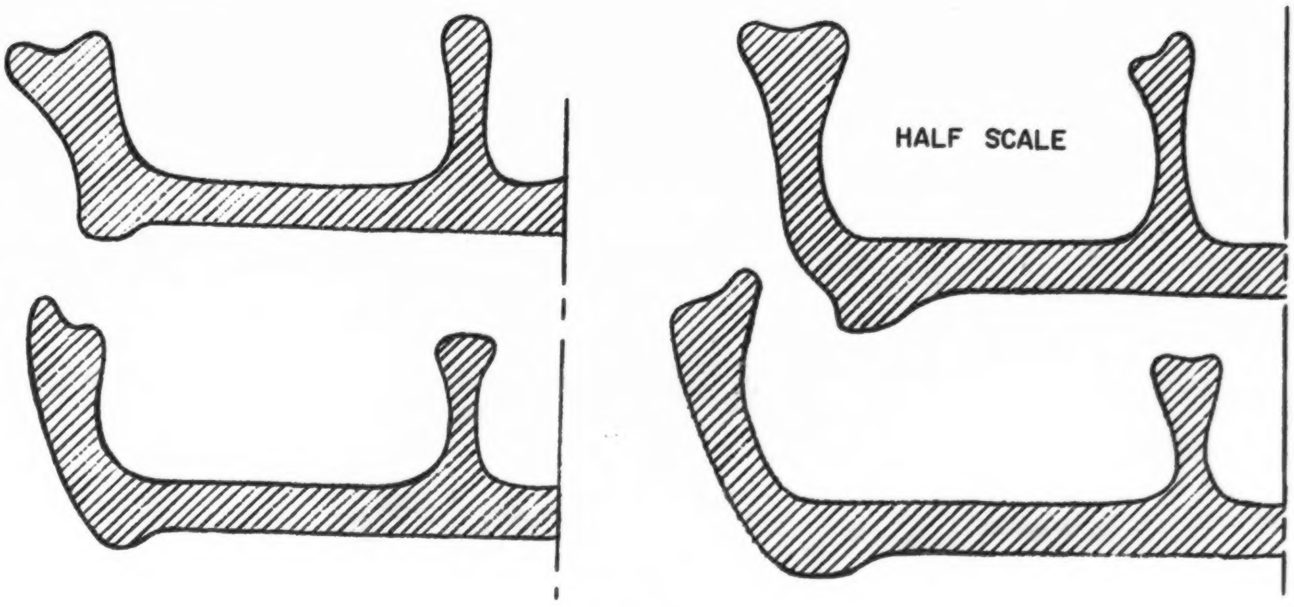
Here is an ashtray whose maker has the pipe smoker in mind. A large cork in the center of a generous container enables one to knock the pipe clean without damage or unnecessary noise.



Working Drawing


6" TO 8"
NO. 3 CORK
$1\frac{1}{2}$"
RIM TO REMAIN UNGLAZED FOR MATCH STRIKING PURPOSES.

Alternate Designs



Research Activities

Investigate the Turkish water pipe.

Use another material for the center plug of the pipe ashtray. Try turning hard rubber, cork, plastics, and/or various kinds of wood.

Procedure

The only variation to standard procedure is that in the original opening-up process allowance is made for a cone of clay to remain in the center. The design calls for throwing a cylinder within a cylinder that has a common base.

Precaution should be taken in throwing the center cylinder in that it may have a tendency to exceed the height of the outer rim. This would involve a compensating adjustment if the foot is to be trimmed.

There are large selections of corks available in many hardware and department stores. It is suggested that one secure the type of cork he intends to use first and then adjust the inside diameter of the center cylinder during the throwing process.

Related Technical Information

Designing Throwing Bats:

If a number of pieces are to be thrown more or less with the same diameter it would be worthwhile to make a plaster bat (or a number of them) that incorporates a built-in foot. (See figure 1.) Usually there is an equal amount of time invested in the throwing and later on in the trimming. It should be recognized that a thrown pot will lose some of its character in not having a trimmed foot.

If any number of bats are required a case mold can be made. If desired, key a section out of one of the regular bats and cast a small boss of plaster directly on the wheel. After the plaster sets, trim the profile to suit your purpose. (See figure 2.)

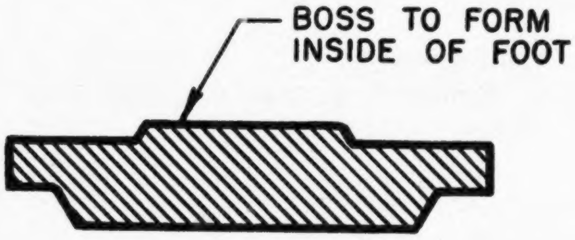


FIGURE 1.

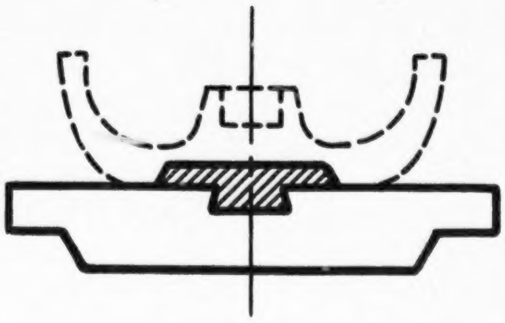


FIGURE 2.

Other topics to explore:

Throwing on a Wooden Wheel Head

Using a Slip-Fastened Platter of Transite as an Aid in Removing Thrown Pots

Demonstrations

Cut a key to lock plaster together for turning.

Use a clay rope for a quick cottle.

Related Cultural Information

Insulating Bricks from Diatoms:

There are many insulating materials on the market today which are used in the construction of kilns. One of the first outstanding materials used for insulation and still in use today is known as diatomaceous earth brick. Diatoms are sea creatures, microscopic in size, whose fossils are practically pure silica. Deposits of this substance are being mined constantly in this country. It is interesting to note that California has deposits that are in excess of 3,000-feet thick. How many billions of years this process required is staggering to comprehend. These bricks are sawed directly from the solid mined material. Slight graduations of color (buff to greys) reveal the successive layers as they were deposited through the centuries. Even the dust of this valuable substance is used with a binder to fabricate other insulating materials.

This is also one of the major constituents of a well-known buffing compound known as tripoli. Diatomaceous earth is also used as a filter material for swimming pools, requiring far less volume than sand and gravel to do the same job.

Other topics to explore:

Insulators and Refractories
Kiln Construction (Inspect the typical cross-section of a production kiln showing insulating and refractory materials.)

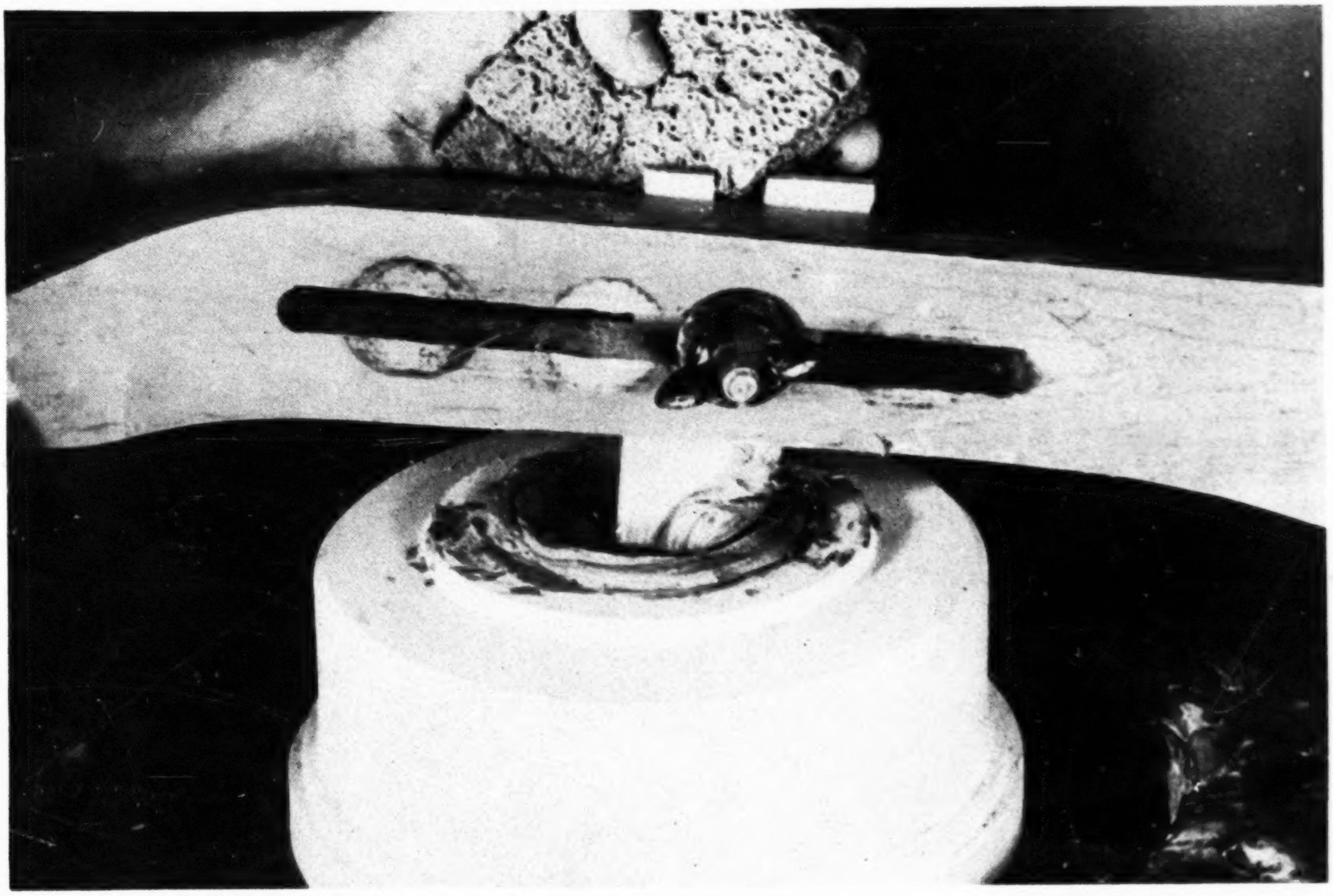
References

Kenny, J. B. *The Complete Book of Pottery Making.* (The Primitive Potter Story.) p. 226

Any Standard Encyclopedia. Diatoms

JIGGERING

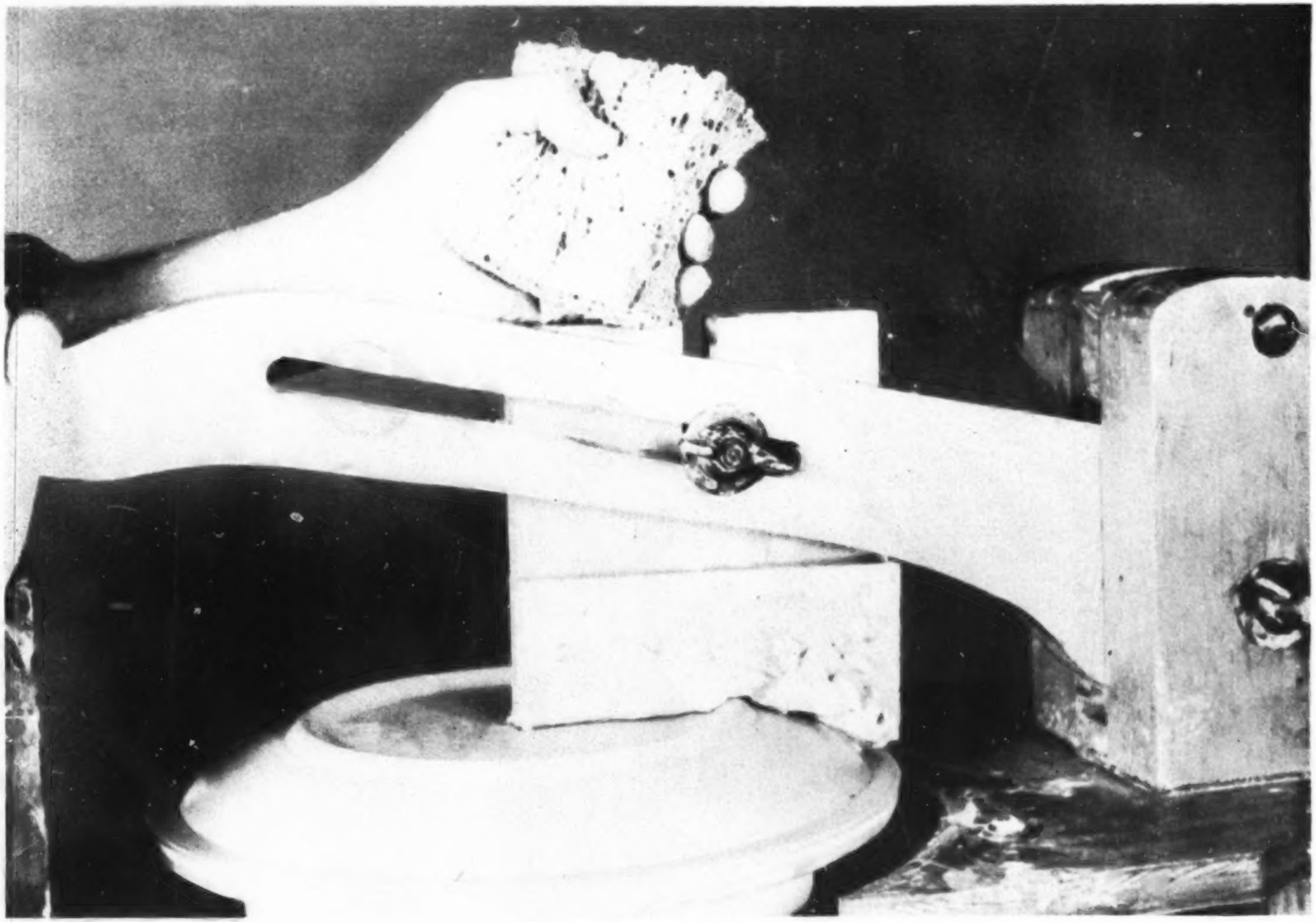
INTRODUCTION TO JIGGERING



Jiggering hollow ware—a cup.

In modern industry, the duplication and mass production of concentric dinnerware forms is accomplished by the mechanical process called jiggering. This is now done in large automatic machines. However, the original jigger machine was an adaptation of the potter's wheel.

Jiggering utilizes contoured plaster molds and bats in conjunction with matched shaping tools (see units, Flatware Attachments and Hollow Ware Attachments). These tools are held in position over the contoured bats (or molds) by the jigger arm (see unit, Jigger Arm). The clay to be shaped is placed on a bat (or in a mold) which is fixed to the potter's wheel head and made to spin. The shaping tool is then pulled onto the spinning clay, pressing it into the shape and thickness desired. As soon as one piece is jiggered, it is removed from the machine still adhering to its bat and set aside to dry. A duplicate bat (or mold) is set in place and the procedure is repeated as often as required.



Jiggering flatware—a dish.

The production of flat and hollow ware varies slightly. When shaping flatware, such as a dinner plate, the clay is shaped on a contoured jigger bat in an inverted or an upside-down position. (See figure 1.) When shaping hollow ware, such as a cup, the clay is shaped in a deep contoured mold in an upright position. (See figure 2.) This difference in procedure is dictated by the contours of the ware and shrinkage of clay on the solid mold surfaces. The hinge action and swing of the jigger arm dictate the location of the jigger tools on one side or the other of the wheel head.

JIGGERING FLATWARE

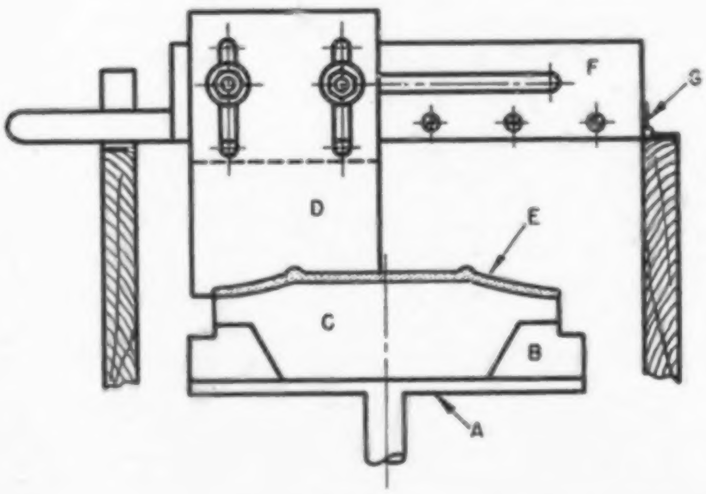


FIGURE 1.

JIGGERING HOLLOW WARE

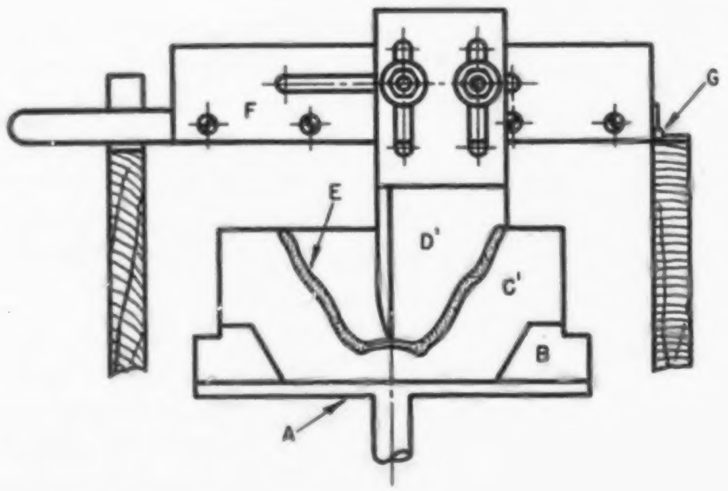


FIGURE 2.

A	WHEEL HEAD
B	PLASTER CHUCK
C	JIGGER BAT
C¹	JIGGER MOLD
D	CLAY SHAPING TOOL FLATWARE
D¹	CLAY SHAPING TOOL HOLLOW WARE
E	SHAPED CLAY
F	JIGGERING ARM ATTACHMENT
G	HINGE

To set up a unit for jiggering, the following steps would have to be taken:

Equip the potter's wheel with a jigger arm attachment.

Equip the wheel with a commercial plaster chuck or cup head designed to hold a jigger bat or mold.

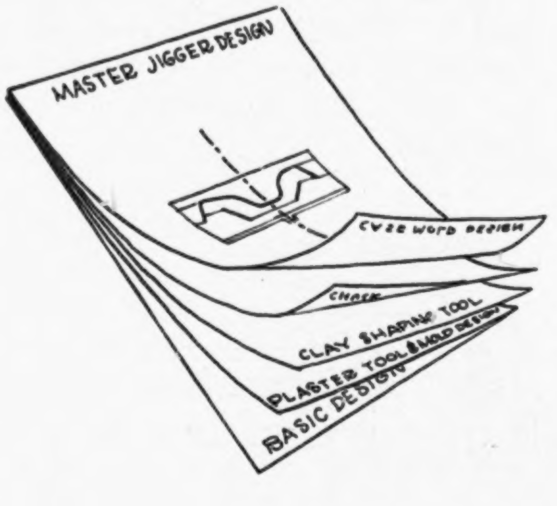
Design flat or hollow ware, making master jiggering profile designs.

Make bat (or mold) cutting tools from master designs.

Some confusion exists relative to the use of the term jolly. While jiggering is a general term applied to the mechanical method and the machine used for making flat and hollow ware, a jolly is a special machine tool. It is used to make deep hollow ware by operating a forming tool on vertical rods. It is not limited by the arc of travel of a tool mounted on a jigger arm. In the past the head that held the mold was called the jolly. Modern practice in this country tends to avoid the use of the term jolly.

The following units include procedures for creating master designs for jiggering, a practical design for a jigger arm attachment, ways of making mold cutting and clay shaping tools, and the procedures for jiggering flat and hollow ware.

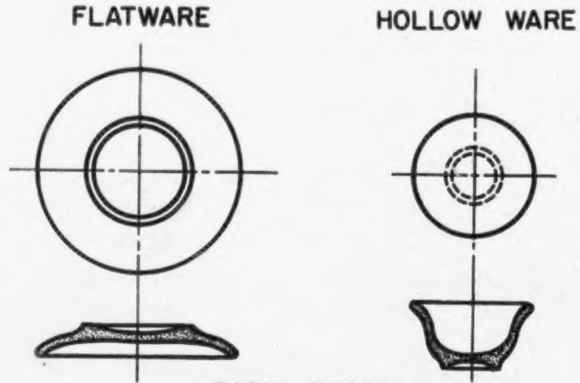
MASTER JIGGERING DESIGN



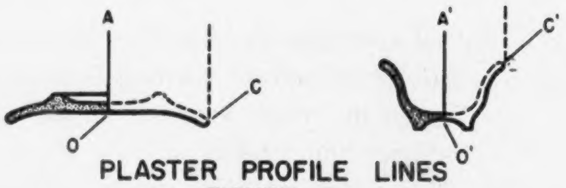
A master jiggering design is created as a series of overlay drawings beginning with a cross-sectional view through the diameter of the intended project. A perpendicular center line is drawn, bisecting the cross-sectional view. Flatware is drawn upside down and hollow ware is drawn right side up. (See figure 1.)

The contour lines of the project are now established. Since the ware is shaped while spinning, only half of the length of the contour line is necessary to determine the shape and design of the jiggering tools.

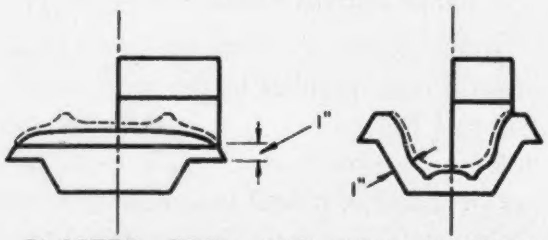
The first overlay shows lines A, O, C, for flatware, and A′, O′, C′, for hollow ware. (See figure 2.) These lines become the profile of the plaster cutting tools which shape the bats or molds for the respective projects. (See the units, Flatware Attachments, Hollow Ware Attachments, Plate, and Cup.) The thickness of the plaster bat or mold should never be less than ¾ inch at any point. This limitation must be considered when completing bat and mold designs, as in figure 3, overlay 1. (For detailed procedure in making jigger bats and molds, see units Plate and Cup.)



BASIC DESIGN
FIGURE 1



PLASTER PROFILE LINES
FIGURE 2



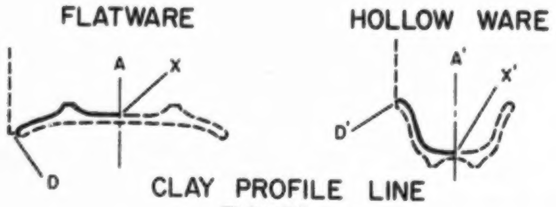
PLASTER TOOL AND MOLD DESIGNS
OVERLAY 1
FIGURE 3

The second overlay involves lines A, X, D, (flatware), A′, X′, D′, (hollow ware). (See figure 4.) These lines are the contour lines which determine the profiles of the clay shaping tools. Complete the clay tool designs as in figure 5. (For details on construction of clay shaping tools for jiggering, see units, Flatware Attachments, Hollow Ware, Plate, Cup, and Contoured Hollow Ware Tool.)

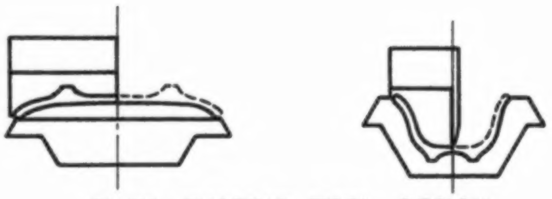
The design of the chuck which holds the bat or mold during shaping is dictated by the wheel head, its joggles and notches, and the contours of the projects. The overall diameter and thickness of the chuck must conform to the wheel head diameter and joggle height. The diameter of the tapered opening into which molds or bats fit is critical only for hollow ware projects. An angle of 60° for the taper and three notches for locking the mold in place are recommended. The third overlay is the design for the plaster chuck. (See figure 6 and construction procedures for plaster chuck in unit, Potter's Wheel Chuck.)

The master design for jiggering now consists of separate designs of a chuck, a bat (or mold), a plaster cutter, and a clay shaping tool. If true mass production is to be undertaken, a case mold design, for the duplication of bats or molds, should be added to our master.

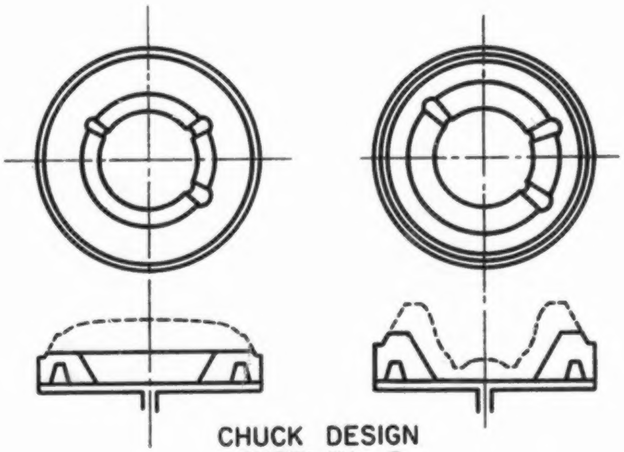
Case mold designs vary for flatware and hollow ware. For flatware, only a contour section need be added to the chuck to complete a case mold. For hollow ware, a contour section and collar must be added. Overlay 4, the design of the case mold, is shown in figure 7. (For construction detail of a case mold see the unit, Cup.)



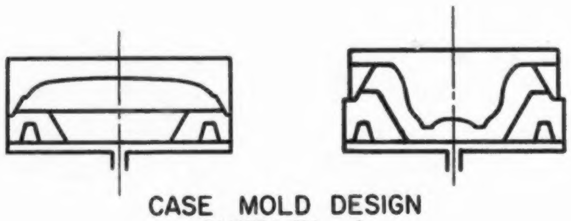
CLAY PROFILE LINE
FIGURE 4



CLAY SHAPING TOOL DESIGN
OVERLAY 2
FIGURE 5



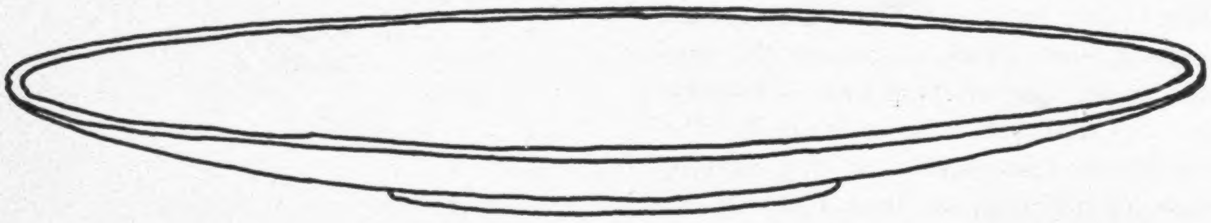
CHUCK DESIGN
OVERLAY 3
FIGURE 6



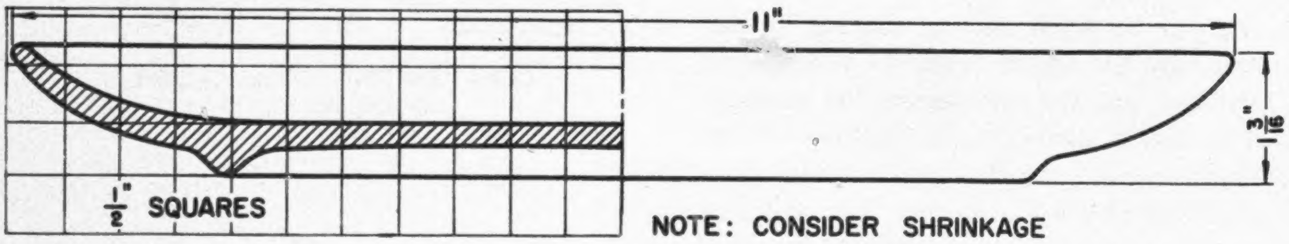
CASE MOLD DESIGN
OVERLAY 4
FIGURE 7

PLATE

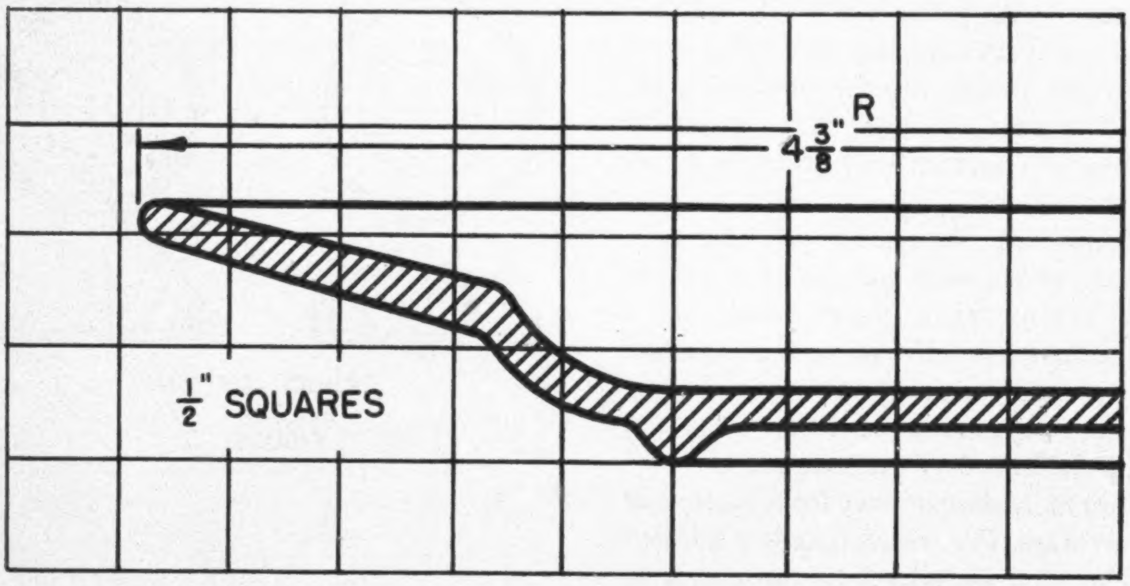
A matched set of plates of original design, and hand painted, will be the pride of a family. Industrial techniques of decoration, such as stenciling, are also readily adapted to a plate design. The making of plates using industrial techniques of production and decoration will provide a good class or group project.



Working Drawing



Alternate Design



Research Activities

Collect discarded plates of different designs and study their cross-sections.

Design and develop multi-colored patterns for stencils.

Visit a pottery factory to observe the jiggering of commercial plates.

Plan an exhibit of commercial plates in cooperation with a local china store.

Procedure

Design plate full size (consider shrinkage). (See unit, Master Jiggering Design.)

Lay out, cut, file, and assemble plaster cutter and jiggering (clay shaping) tool. (See the units, Flatware Attachments and Jigger Arm.)

Place chuck on head or wheel. (See unit, Potter's Wheel Chuck.)

Shaping the plaster bat:

Lower jigger arm to stop position.

Locate jigger bat cutter on jigger arm so that hinge action of the arm will lift cutter up and away from plaster. (See figure 1.)

Adjust jigger bat cutter to correct position by aligning index mark of the cutter perfectly vertical (check with trisquare on wheel head), and directly over dead center of head. Cutting tool height should be set so that the resulting plaster jigger bat will be a minimum of 1 inch thick. (See figure 1.)

Clamp or lock jigger bat cutter to jigger arm.

Raise jigger arm to vertical position.

Size chuck.

Place a cottle (larger in diameter and higher than the desired jigger bat) on the chuck.

Mix plaster, test, and pour into the cottle.

Remove cottle when the plaster starts to set (approximately five to ten minutes).

Start the jigger and bring down the plaster cutter, gradually cutting the soft plaster until the arm reaches the stop.

Place arm in vertical position and if necessary turn the outside diameter of the jigger bat smooth.

Smooth the jigger bat with a fine abrasive rubber scrubber or fine sandpaper.

Remove the jigger bat from the chuck and allow to dry.

Shaping clay into a plate:

Place the jigger bat in the chuck.

Set the jiggering (clay shaping) tool. It is usually located as close to hinge of jigger arm as possible, hence on opposite side of wheel from that used for plaster cutting. Adjust cutter to desired thickness of the plate (as in the procedure for jigger bat). Test by placing a slab of clay on a damp cloth over the jigger bat, and making a test dish.

Prepare a ball of clay for batting out large enough to form a clay bat larger in diameter and thicker than the desired plate.

Bat out clay bat. (See unit, Batting Block and Batter in Tools and Equipment.)

Place the clay bat on the moistened jigger bat.

Bring down jigger arm, pressing and cutting clay to shape until the jigger arm reaches the stop. Keep clay moistened with a sponge while jiggering. (See Dougherty, J. W. *Pottery Made Easy,* pp. 139-140.)

Trim the excess clay from the edge.

Remove the jigger bat from the chuck and allow to dry. (Moisten edge if it dries faster than center.)

Remove the plate from the jigger bat as soon as possible (when the clay is stiff and has freed itself).

Smooth the rim.

Allow to dry.

Bisque fire.

Apply glaze.

Glaze fire.

Decorate when plate is in condition for desired decoration.

Related Technical Information

Mass Production Decoration:

Jiggered plates lend themselves very nicely to underglaze stencil decoration, with uniform control of line and color, yet may be decorated with extreme speed by use of a form-fitting stencil.

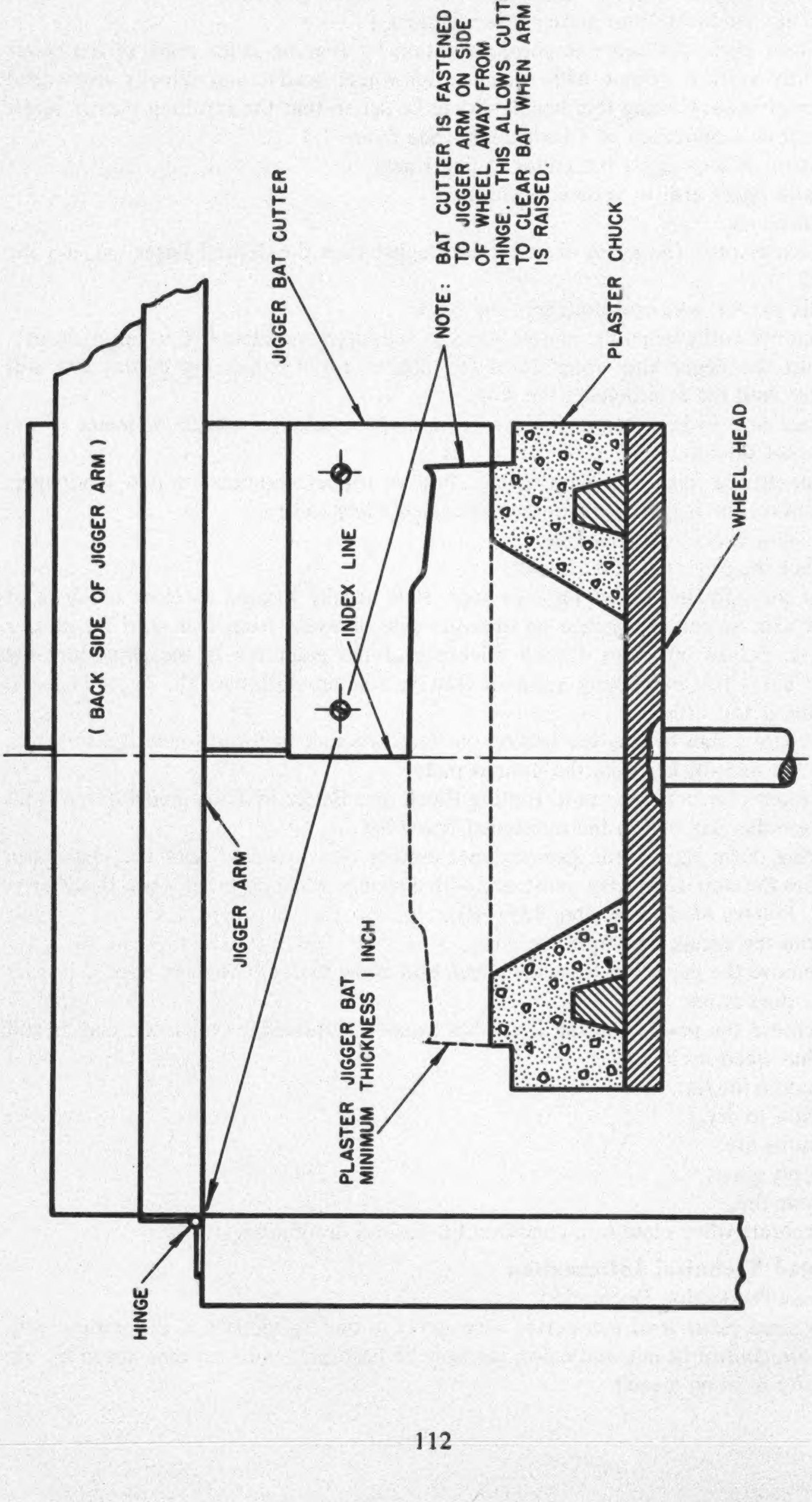

(BACK SIDE OF JIGGER ARM)
JIGGER ARM
HINGE
PLASTER JIGGER BAT
MINIMUM THICKNESS 1 INCH
INDEX LINE
JIGGER BAT CUTTER
PLASTER CHUCK
WHEEL HEAD

FIGURE I

NOTE: BAT CUTTER IS FASTENED TO JIGGER ARM ON SIDE OF WHEEL AWAY FROM HINGE. THIS ALLOWS CUTTER TO CLEAR BAT WHEN ARM IS RAISED

Stencils developed by this technique are made of either aluminum foil, lead foil or copper foil. Foil is used to insure easy pressing with fingers or modeling tools to the contour of the plate surface. Lead foil, if available, works with considerable ease with no apparent hardening during the forming operation. Either lead or copper may be reinforced with wire soldered in position with little difficulty, whereas aluminum will offer problems in soldering. The foil used should be between .015 and .030 inch in thickness for ease in cutting with regular stencil knife.

The procedure for developing this type of work can be broken down into three categories: Developing stencil design: layout, forming and cutting; and using stencil.

When developing a design, use simple, basically geometric shapes, because a complicated design of fine lines will cause weakened parts in the stencil and allow color to flow under the edges. Sharp protruding points should be kept to a minimum. Sharp protruding parts are always difficult to cut as well as stencil, since a stencil will have a tendency to curl up and pull from the contour of the plate.

Two or more stencils may be developed so that multi-shading effects with overlapping colors can be achieved. Extreme care and patience must be exercised in making stencils so that proper register will be achieved. (See figure 2.)

After the design has been developed on paper, cut a piece of foil about 1½ inches larger than the diameter of the plate. Press this foil with fingers into the contour of a bisque-fired plate, starting at the centermost portion and smoothing out toward the edges. Any extra foil will serve as a flap over the edges to prevent over-spray or color spatter. This flap can also be aligned with a jig by placing notches or holes in the foil. This is necessary when using two or more stencils which must be positioned in exact location.

Next, transfer design from paper to foil by use of carbon paper. Cut stencil with regular stencil knife using long even-pressured strokes. It may be necessary to make two passes with the knife to insure a good clear cut. Be extra careful at this point to prevent flattening out of the contour-formed stencil; since it is very difficult to bring it back once it has been cut.

It may be necessary to reinforce certain parts which are likely to be weak. This is achieved by placing strips of copper or brass wire on the surface and soldering in position as illustrated. (See figure 2.)

After cutting and reinforcing has been completed, file all rough edges and spots where solder has flowed over edges.

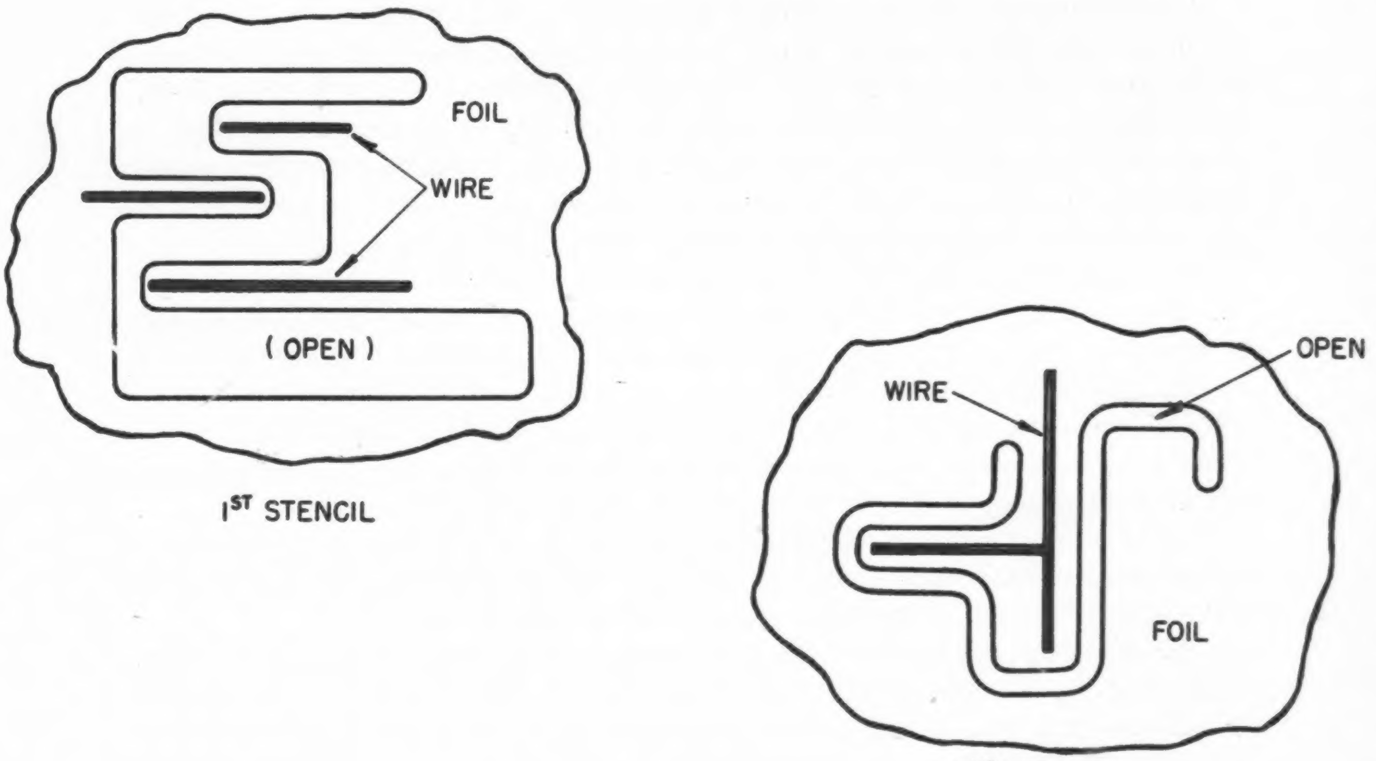
A handle can also be added to give additional pressure for contact and for easy removal of stencil. An excellent material for the handle is brazing rod, bent and soldered in the desired location on the stencil.

Color may be applied through the stencil by various methods. Airbrush technique offers one of the easiest methods of application, since the color is sprayed through the stencil. Sponging works satisfactorily but one must use extreme care not to jar or move the stencil while applying color. One might also brush colors or even spatter them. Experimenting must be done to tell which method of application will prove most satisfactory.

This method of decoration can be used with excellent results, especially in the production of a number of identical pieces. Possibilities are wide for the usage: matched dinnerware sets, mass-produced souvenirs, place cards for banquets and many other types of projects where duplication is desired.

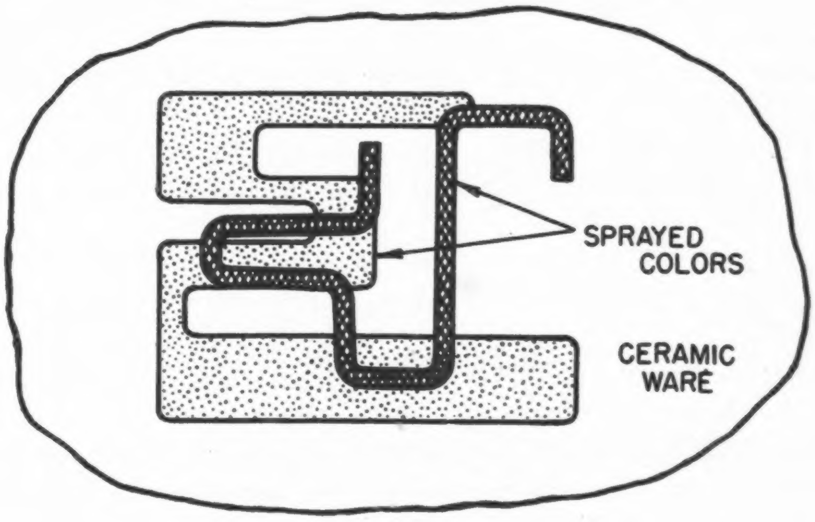
Other topics to explore:

Stacking Plates
Decorating with Decalcomanias
Hand Painting of China Plates


FOIL
WIRE
(OPEN)
WIRE
OPEN
FOIL

1ST STENCIL

2ND STENCIL


SPRAYED COLORS
CERAMIC WARE

TWO OVERLAPPING COLORS

FIGURE 2

Demonstrations

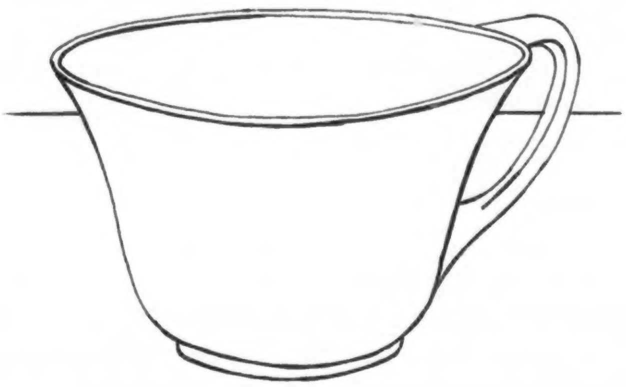
Make profiles for cutters.
Center and adjust plaster cutter and jiggering tool.
Cut jigger bat.
Bat out clay bat.
Press and cut plate with jigger tool.

References

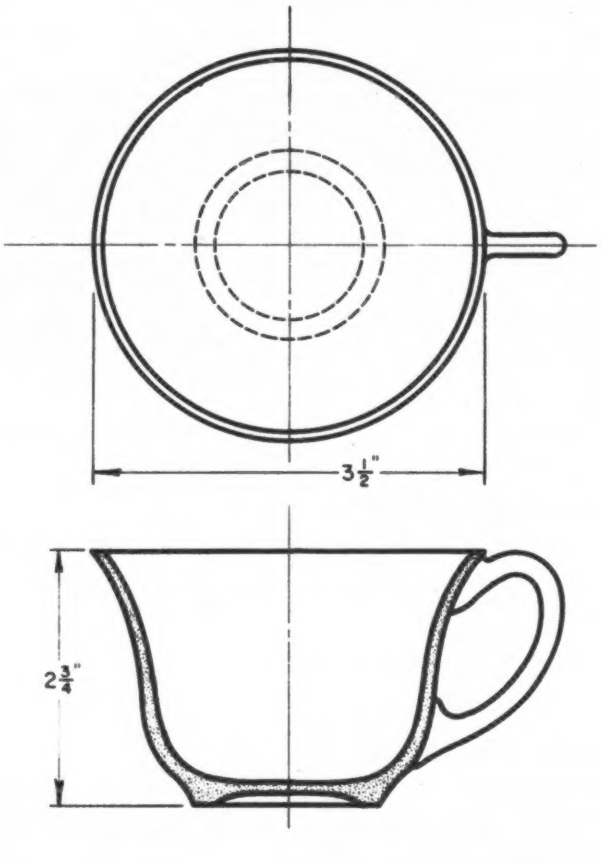
Dougherty, J. W. *Pottery Made Easy*. pp. 139-140
Norton, F. H. *Ceramics for the Artist Potter*. pp. 30-32

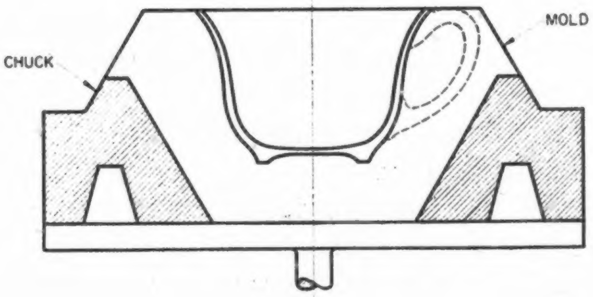
CUP

Undertaking the production of a cup will be a rewarding experience in ceramics mass production. This project involves designing, tool manufacture, mold making, clay preparation, mechanical shaping, decorating, firing, and glazing of mass-produced ceramic ware.



Working Drawing





CHUCK AND MOLD DESIGN

Research Activities

Trace the development of drinking vessels from early civilizations or cultures, to the present.

Study the uses and shapes of handles on cups.

Collect old cups and other drinking vessels.

Design a matched set of dinnerware.

Procedure

Design cup, consider shrinkage.

Develop master jigger design to include chuck, plaster mold cutter, mold, contoured shaping tool, and case mold sections. (See the unit, Master Jiggering Design.)

Layout, cut, assemble, shape, and finish plaster mold cutter. (See units, Hollow Ware Attachments and Jigger Arm.)

Layout, cut, assemble, shape, and finish shaping tool. (See the units, Hollow Ware Attachments and Contoured Hollow Ware Tool.)

Make plaster chuck, as per master design. (See unit, Potter's Wheel Chuck.) Set plaster chuck in place on potter's wheel head.

Shaping the mold:

Clamp plaster mold cutter to jigger arm, with index line of cutter perfectly vertical and directly over dead center on wheel head. Leave at least 1-inch of space between cutter and wheel head. Check clearance of cutter as it will enter and leave the mold it will cut.

Raise and lock jigger arm and cutter in vertical position.

Size plaster chuck.

Assemble cottle and fasten about chuck and wheel head.

Mix plaster, pour into cottle.

Remove cottle when plaster starts to set.

Start machine spinning, lower jigger arm and cutter slowly into soft plaster cutting plaster until jigger arm reaches stop position.

Raise and lock jigger arm in vertical position.

Trim new mold wherever necessary with plaster turning tools. Smooth with fine abrasive rubber scrubber as plaster sets hard. Remove mold from machine and set to dry.

Remove plaster cutter from jigger arm.

Shaping the cup:

Replace the dry mold in the chuck.

Lower the jigger arm to the stop position and fasten the contoured hollow ware shaping tool to the jigger arm determining final position by testing with wads of clay between mold surface and tool edge.

Raise and lock jigger arm and shaping tool in vertical position.

Wipe mold surface with clean damp sponge.

Shape wedged clay into ball and throw forcibly into bottom of mold.

Start machine spinning and lower jigger arm slowly until stop position is reached. Spray water between tool and clay while piece is being shaped. Excess clay will automatically rise to the top edge of the mold.

Raise jigger arm to vertical position and lock in place.

Trim excess clay from top of mold.

Wipe trimmed edge of clay with soft damp sponge.

Remove mold from machine and allow clay ware to dry.

Remove shaped cup body from mold as soon as clay shrinkage indicates separation of clay from plaster mold.

The cup handle may be formed by solid casting, press molding or hand. It must be of the same material as the body of the cup and of similar consistency when it is attached.

Roughen handle ends and cup surface at area of joint.

Apply slip to roughened areas.

Fasten handle to cup with firm pressure.

Wipe off excess slip and smooth entire piece with sponge.

Allow to dry.

Bisque fire.

Apply glaze.

Glaze fire.

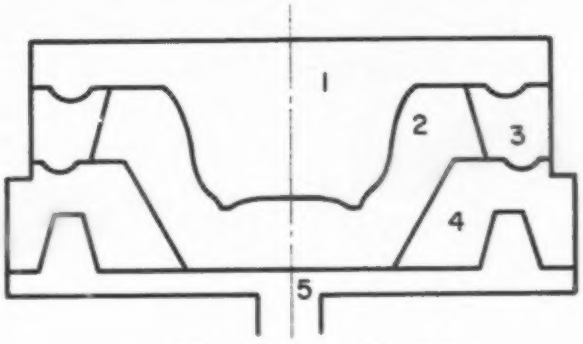
Apply decoration when cup is in condition for desired decoration technique.

Related Technical Information

Mass Production of Jigger Bats or Hollow Ware Molds:

Duplication of jigger bats or hollow ware molds is essential for mass production jiggering. A case mold designed with one section as the chuck in which the subsequent bats or molds fit during jiggering, assures perfect duplication of bats or molds and the ware made from them. (See figure 1.)

A flat wheel head must be equipped with jogs to hold the chuck in place. Three standard football shoe cleats spaced irregularly in the wheel head make good jogs, which provide for easy removal of the chuck. (See figure 2.)



1 CONTOURED SECTION
2 MOLD - BLOCK
3 COLLAR SECTION
4 CHUCK
5 WHEEL AND JOGGLES

FIGURE 1

Make chuck section of case mold: Set cottle about wheel head; pour and allow plaster to set to plastic state; remove cottle; with plaster turning tools, cut to shape as illustrated (see figure 3); when fully set, smooth plaster with rubber scrubber and allow to dry.

Make block mold model to be duplicated: Clamp plaster mold cutter to jigger arm, use index mark to locate position; raise and lock arm. Thoroughly size the dry plaster chuck; set cottle on shoulder of chuck; mix, pour, and allow plaster to set to plastic state; cut block mold to shape by lowering jigger arm to full stop position while wheel turns; trim and finish block mold; allow to dry.

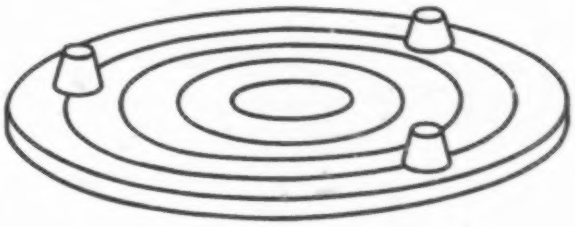


FIGURE 2

If block mold is for hollow ware, it must now be cut vertically in two. (See figure 4.) This is necessary to prevent binding of other sections to follow. This step is not needed for jigger bats. Replace block mold sections in chuck and size all surfaces thoroughly.

To make the collar section: Set cottle about the outside of the chuck; mix and pour plaster to top edge of block mold.

When plaster sets, remove cottle, trim and cut joggle holes. Remove donut-shaped collar from chuck and block mold and when dry cut vertically in two as in figure 5. Replace on and about chuck and block mold. Size all surfaces.

To make contour section of case mold: Reset cottle about chuck and collar sections; mix and pour plaster into and 1 inch above top edge of case mold; when set, remove cottle, trim and smooth outer surfaces (see figure 6); separate all mold parts and allow to dry completely; discard block mold pieces.

To case new hollow ware molds: Size the chuck, collar and contour sections of the case mold thoroughly; assemble all the sections and bind together with heavy rubber bands; set on flat surface with contoured section on bottom and chuck on top (see figure 7); mix and pour plaster into opening of case mold until filled just shy of top. Disassemble case mold when plaster is set and remove new mold.

Repeat casting into case mold for each duplicate mold or bat desired.

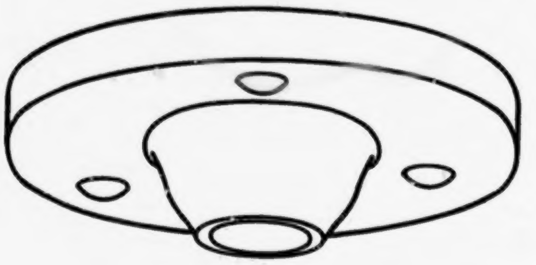


FIGURE 6.

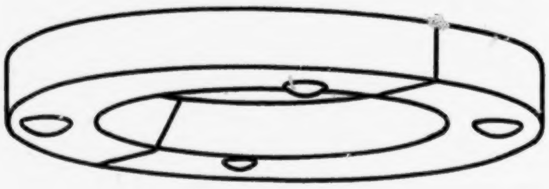


FIGURE 5.

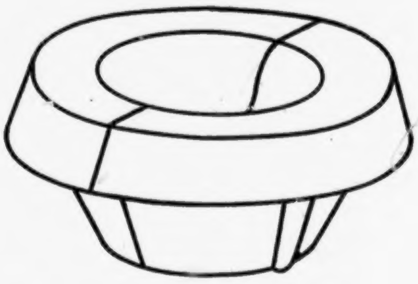


FIGURE 4.

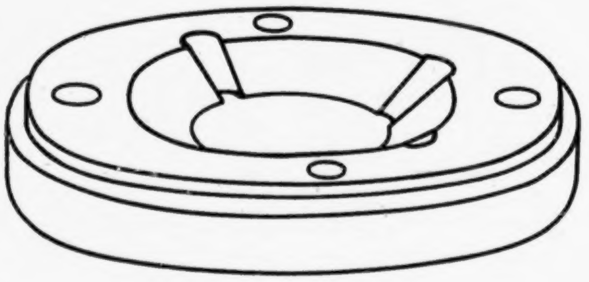
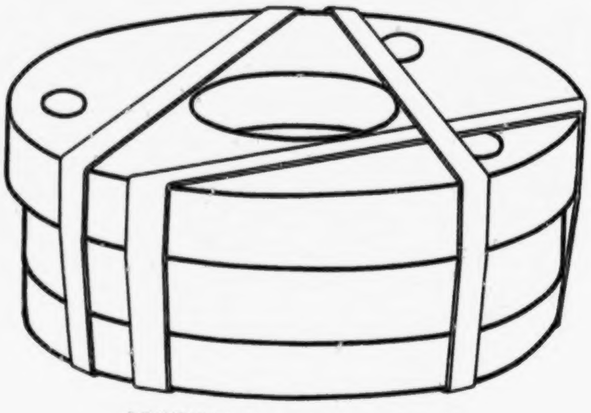


FIGURE 3.



ASSEMBLED CASE MOLD
READY FOR CASTING
FIGURE 7

3

Other topics to explore:

- Proper Stacking of Cups and Bowls for Bisque or Glaze Firing
- Designs of Foot Rims for Cups and Bowls
- Manufacture of Jigger Bats and Molds With Raised or Textured Designs on Their Surfaces

Demonstrations

How to make a contoured shaping tool.

How to locate the correct position of plaster mold cutting tool and contoured shaping tool.

How to make a hollow ware mold.

How to jigger a cup.

How to fasten handles or other appendages.

Related Cultural Information

New Uses for Clay Products:

It has often been said that the manufacture of ceramics is one of the oldest of man's industries. One notes with interest that clay, the raw material of the cave man, is still of major importance in today's world. More interesting, are the newest applications, developments and discoveries involving ceramic clay products. In an age in which electronics, space vehicles, and atomic energy are the ultimate of man's achievements, clay products are still important. Developments such as electronic semi-conductors and pyroceram for missile nose cones are only two of the many new ceramic products. The role of clay products of the future would seem to indicate continued increasing importance for one of man's oldest industries.

References

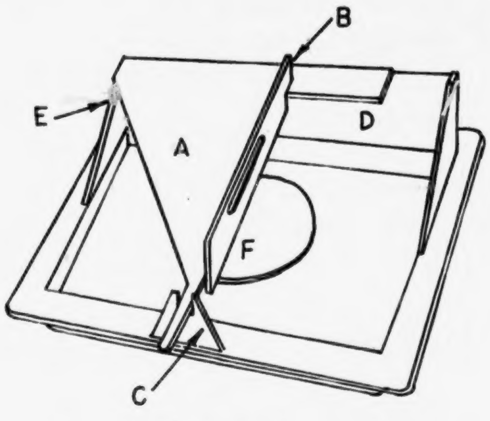
Binns, C. F. *The Potter's Craft.*

Dougherty, J. W. *Pottery Made Easy.*

Norton, F. H. *Ceramics for the Artist Potter.*

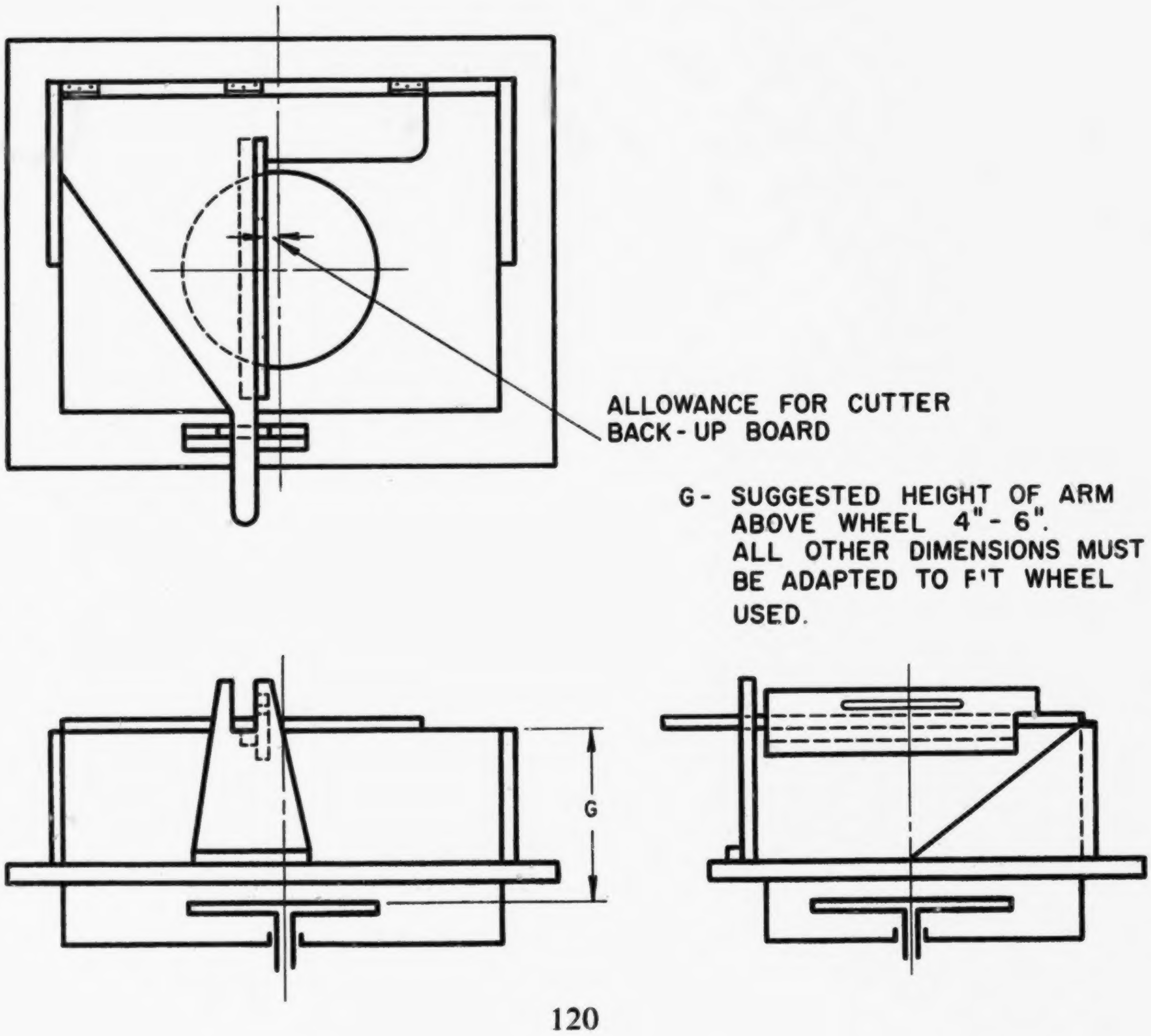
JIGGER ARM

Any potter's wheel is adaptable to the jiggering process by the use of a jigger arm. Jiggering tools are clamped to the jigger arm, therefore, the arm must be rigidly supported. Its rigidity and position make it possible to maintain the exact location of the tool in reference to the center of the potter's wheel.



A	JIGGER ARM
B	TOOL MOUNTING BOARD
C	JIGGER ARM STOP
D	BACK BOARD
E	SIDE BRACE
F	WHEEL HEAD

Working Drawing



ALLOWANCE FOR CUTTER BACK-UP BOARD

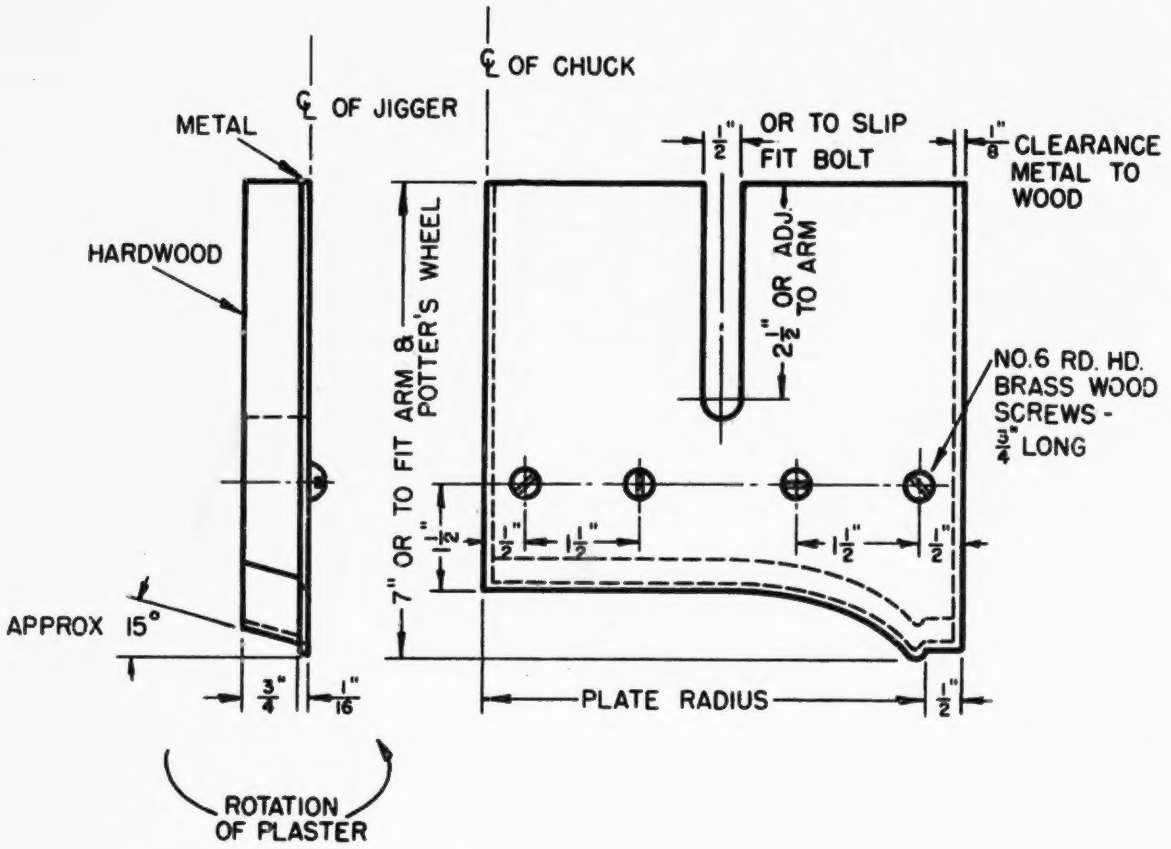
G - SUGGESTED HEIGHT OF ARM ABOVE WHEEL 4" - 6". ALL OTHER DIMENSIONS MUST BE ADAPTED TO FIT WHEEL USED.

The arm must swing from a vertical to a horizontal position to allow for the placing of chucks, bats, and collets on the wheel. The thickness of the object being jiggered is controlled by the adjustment and placement of the tools as they are fastened to the jigger arm. The arm in turn fits into an arm stop. The arm stop serves to maintain the position of the tools on center as well as acting as a height stop. Four to six inches of clearance between the wheel surface and the arm (when in horizontal position) is suggested. When not in use the arm with tools attached is swung up out of the way. Either the arm must go far enough beyond the vertical position to stay up or a special locking device will be needed. External, ¾-inch five-ply fir is a suggested material to use.

FLATWARE ATTACHMENTS

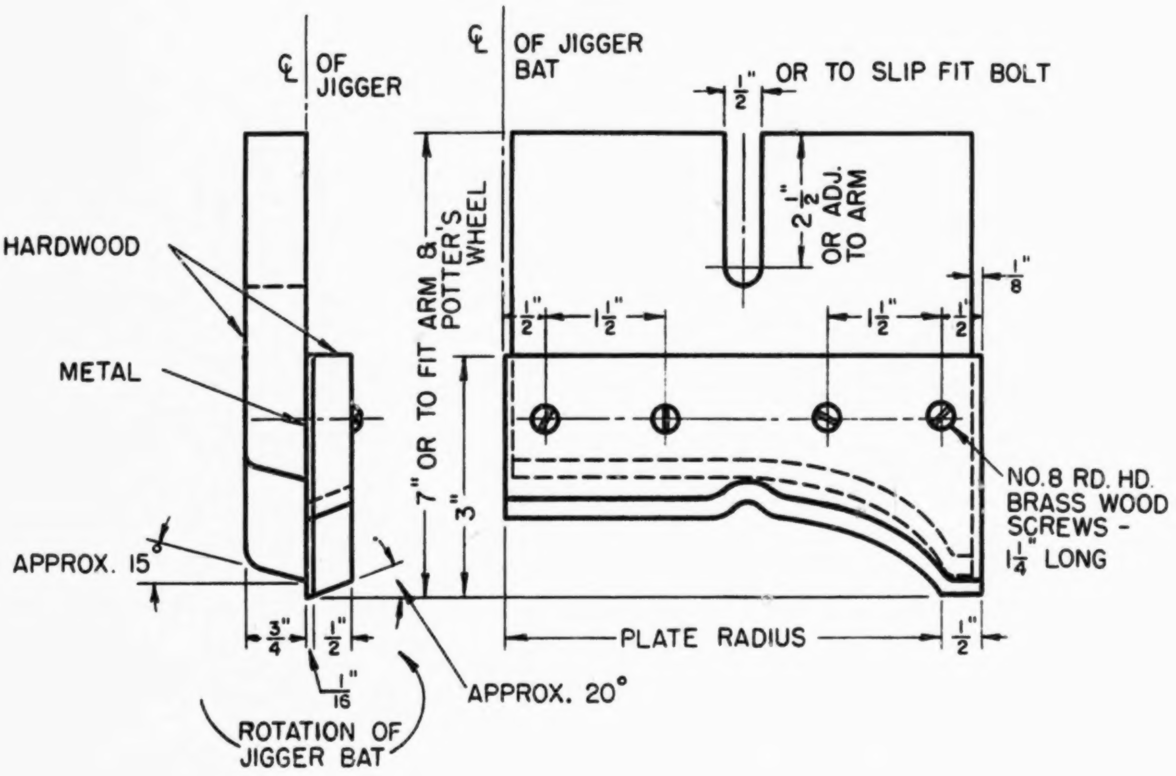
These attachments consist of two tools which can be clamped to the jigger arm of the potter's wheel—the flatware plaster cutter and the flatware clay shaping or jiggering tool.

PLASTER CUTTER



℄ OF CHUCK
℄ OF JIGGER
METAL
HARDWOOD
1/2" OR TO SLIP FIT BOLT
1/8" CLEARANCE METAL TO WOOD
2 1/2" OR ADJ. TO ARM
7" OR TO FIT ARM & POTTER'S WHEEL
NO.6 RD. HD. BRASS WOOD SCREWS - 3/4" LONG
1 1/2"
1/2"
1 1/2"
1 1/2"
1/2"
APPROX 15°
3/4"
1/16"
PLATE RADIUS
1/2"
ROTATION OF PLASTER

JIGGERING TOOL



℄ OF JIGGER
℄ OF JIGGER BAT
1/2" OR TO SLIP FIT BOLT
2 1/2" OR ADJ. TO ARM
1/8"
HARDWOOD
METAL
7" OR TO FIT ARM & POTTER'S WHEEL
3"
1/2"
1 1/2"
1 1/2"
1/2"
NO.8 RD. HD. BRASS WOOD SCREWS - 1 1/4" LONG
APPROX. 15°
3/4"
1/2"
1/16"
APPROX. 20°
PLATE RADIUS
1/2"
ROTATION OF JIGGER BAT

The plaster cutter is used to shape the plaster jigger bat, figure 1. (See also unit, Plate.)

The jiggering tool shapes the bottom of flatware, figure 2.

Figure 3 is the finished piece of flatware.

The contours for both of these shaping tools are taken from the profiles developed in the master jigger design (see unit, Master Jigger Design). They are transferred to $\frac{1}{16}$- or $\frac{3}{32}$-inch sheet zinc which is cut and filed to shape.

While the mounting-backing boards can be made of pine or poplar, maple makes a more durable tool. These boards must be long enough to suspend the profile plate at the proper height over the wheel head. The (clay forming) jiggering tool has a beveled profile nose piece which aids in forcing the clay surface in place.

When mounting either tool the inside edge of the metal template forms an indexing line to be lined up directly over the center of the wheel.

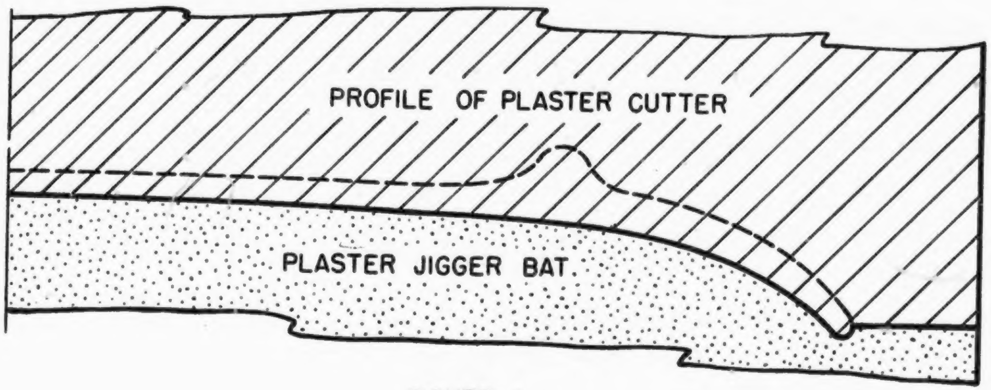

PROFILE OF PLASTER CUTTER
PLASTER JIGGER BAT

FIGURE 1

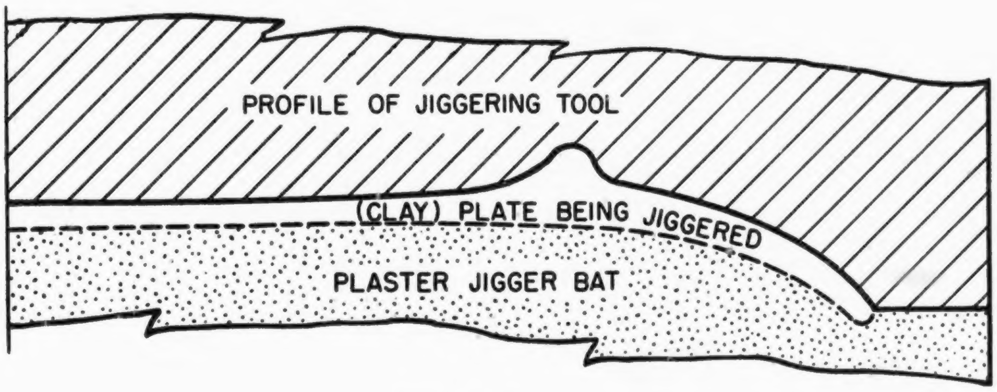

PROFILE OF JIGGERING TOOL
(CLAY) PLATE BEING JIGGERED
PLASTER JIGGER BAT

FIGURE 2

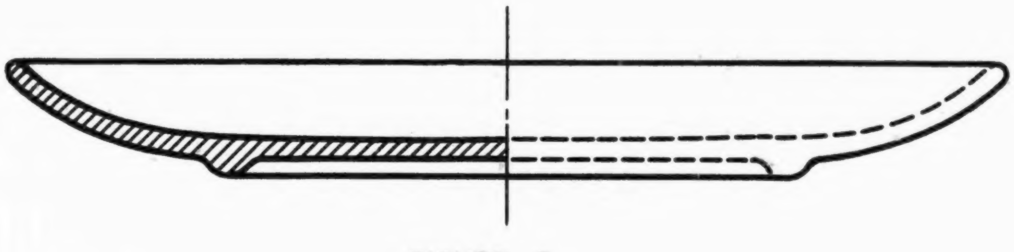


FIGURE 3

Bill of Material

Plaster Cutter

1 piece metal (zinc), 1/16 inch thick x 7 inches wide x 6½ inches long (or approximately 1 inch longer than the radius of the dish to be made)

1 piece hardwood (maple), ¾ inch thick x 6½ inches wide (or approximately to fit the length of the zinc) x 7 inches long

4 brass wood screws, No. 6 x ¾ inch long, round head

Waterproof seal and finish

Jiggering Tool

1 piece metal (zinc), 1/16 inch thick x 3 inches wide x 6½ inches long (or approximately 1 inch longer than the radius of the dish to be made)

1 piece hardwood (maple), ¾ inch thick x 6½ inches wide (or approximately to fit the length of the zinc) x 7 inches long

1 piece hardwood (maple), ½ inch thick x 3 inches wide x 6½ inches long (or approximately to fit the length of the zinc)

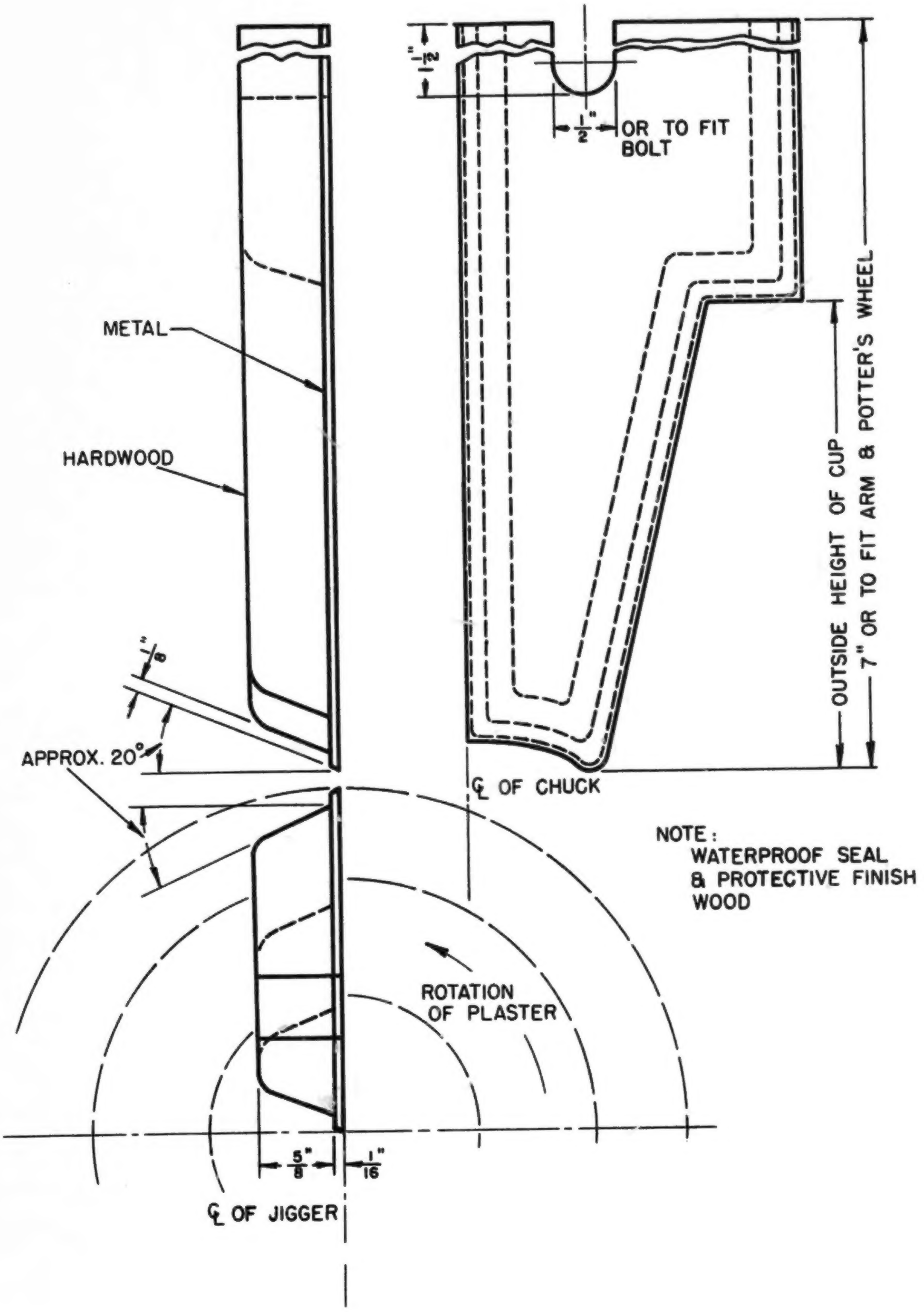
4 brass wood screws, No. 8 x 1¼ inches long, round head

Waterproof seal and finish

HOLLOW WARE ATTACHMENTS

These attachments consist of two tools which are fastened to the jigger arm of the potter's wheel—the hollow ware plaster cutter and the hollow ware clay shaping or jiggering tool.

HOLLOW WARE PLASTER CUTTER


1/2"
1/2" OR TO FIT BOLT
METAL
HARDWOOD
1/8"
APPROX. 20°
℄ OF CHUCK
OUTSIDE HEIGHT OF CUP
7" OR TO FIT ARM & POTTER'S WHEEL
ROTATION OF PLASTER
5/8"
1/16"
℄ OF JIGGER

NOTE:
WATERPROOF SEAL
& PROTECTIVE FINISH
WOOD

The plaster cutter is used to shape the outside form or contour mold (see figure 1). (See also unit, Cup.)

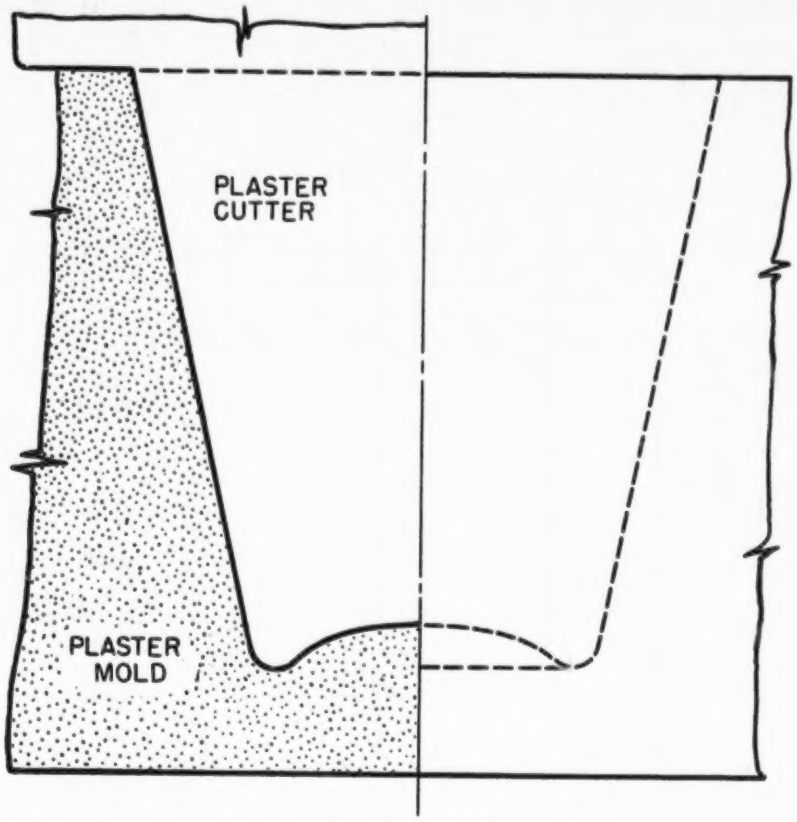

PLASTER CUTTER
PLASTER MOLD

FIGURE 1

The hollow ware jiggering tool shapes and presses clay to form the inside of the ware (see the working drawing titled, Hollow Ware Jiggering Tool on the next page, and figure 2).

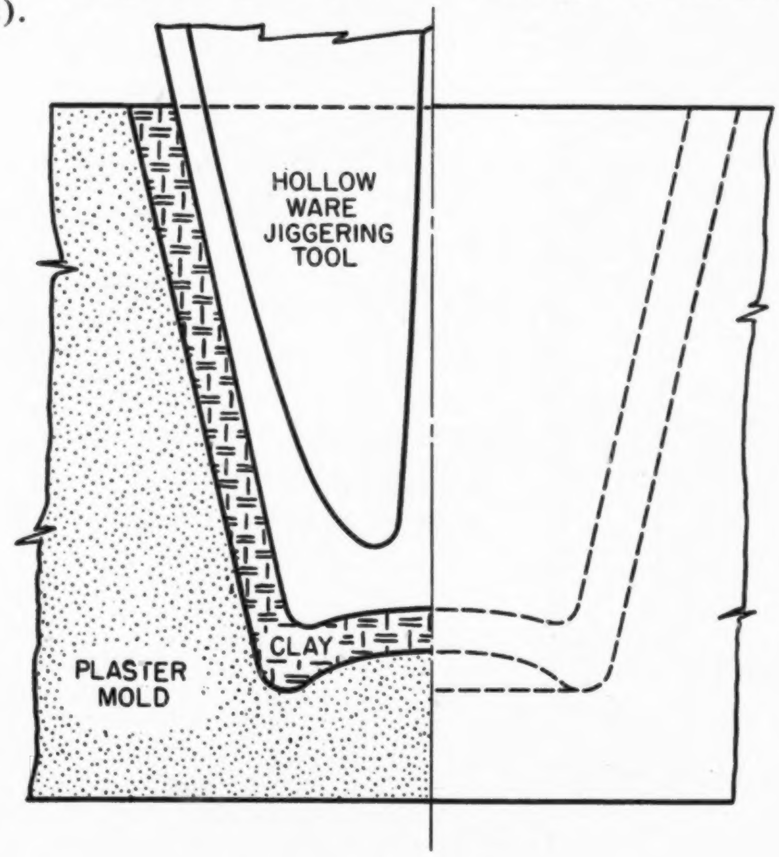
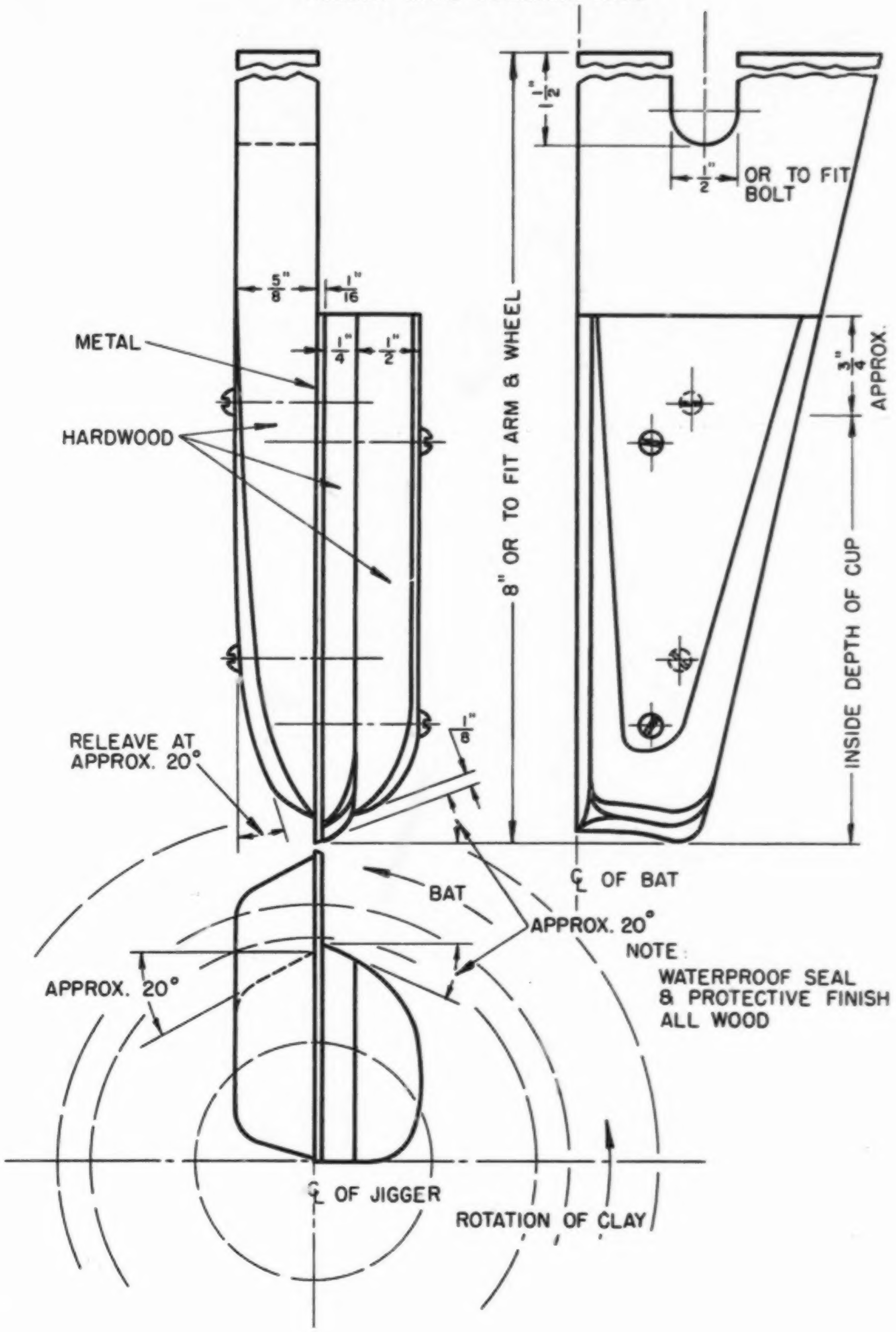

HOLLOW WARE JIGGERING TOOL
CLAY
PLASTER MOLD

FIGURE 2

HOLLOW WARE JIGGERING TOOL


5"/8
1"/16
1"/4
1"/2
METAL
HARDWOOD
RELEAVE AT APPROX. 20°
1"/8
BAT
APPROX. 20°
APPROX. 20°
℄ OF JIGGER
ROTATION OF CLAY
1 1/2"
1"/2 OR TO FIT BOLT
8" OR TO FIT ARM & WHEEL
3"/4 APPROX.
INSIDE DEPTH OF CUP
℄ OF BAT
NOTE:
WATERPROOF SEAL & PROTECTIVE FINISH ALL WOOD

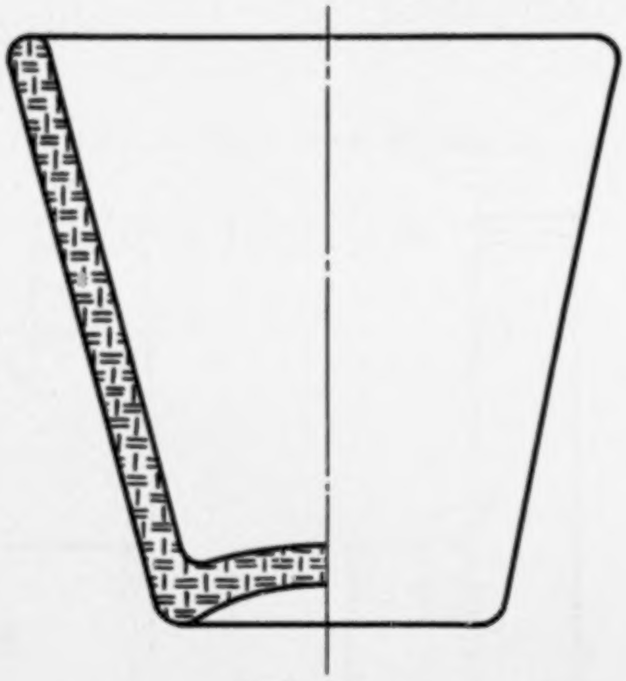


FIGURE 3

Figure 3 is a section drawing of the final piece of pottery.

The shapes of both of these profile plates are transferred from the master jiggering design to $\frac{1}{16}$- or $\frac{3}{32}$-inch sheet zinc. Zinc is readily cut and filed to the desired shape.

While pine or poplar may be used to support the profile plates made for shallow pieces and short runs, a hardwood, such as maple, is used for deeper ware and longer runs.

The hollow ware jiggering tool showed in this working drawing, not only has a mounting-backing piece to support the metal profile, but also a contoured nose piece to wipe clay into the form. The mounting-backing piece must be long enough to permit clamping the tool to the jigger arm while the profile plate is held at the correct height over the wheel. Its contoured edge must be beveled to provide clearance for the clay being shaped. The nose piece must be carefully designed to carry out its wiping action. Another method of designing such a tool is outlined in detail in the unit, Contoured Hollow Ware Tool.

When mounting either of these tools, the inside edge of the metal template forms an indexing line to be lined up directly over the center of the wheel.

Bill of Material

Plaster Cutter

1 piece metal (zinc), $\frac{1}{16}$ inch thick x 2¾ inches wide x 8 inches long
1 piece hardwood (maple), ⅝ inch thick x 2¾ inches wide x 8 inches long
3 brass wood screws, No. 6 x ⅝ inch long, round head
Waterproof seal and finish

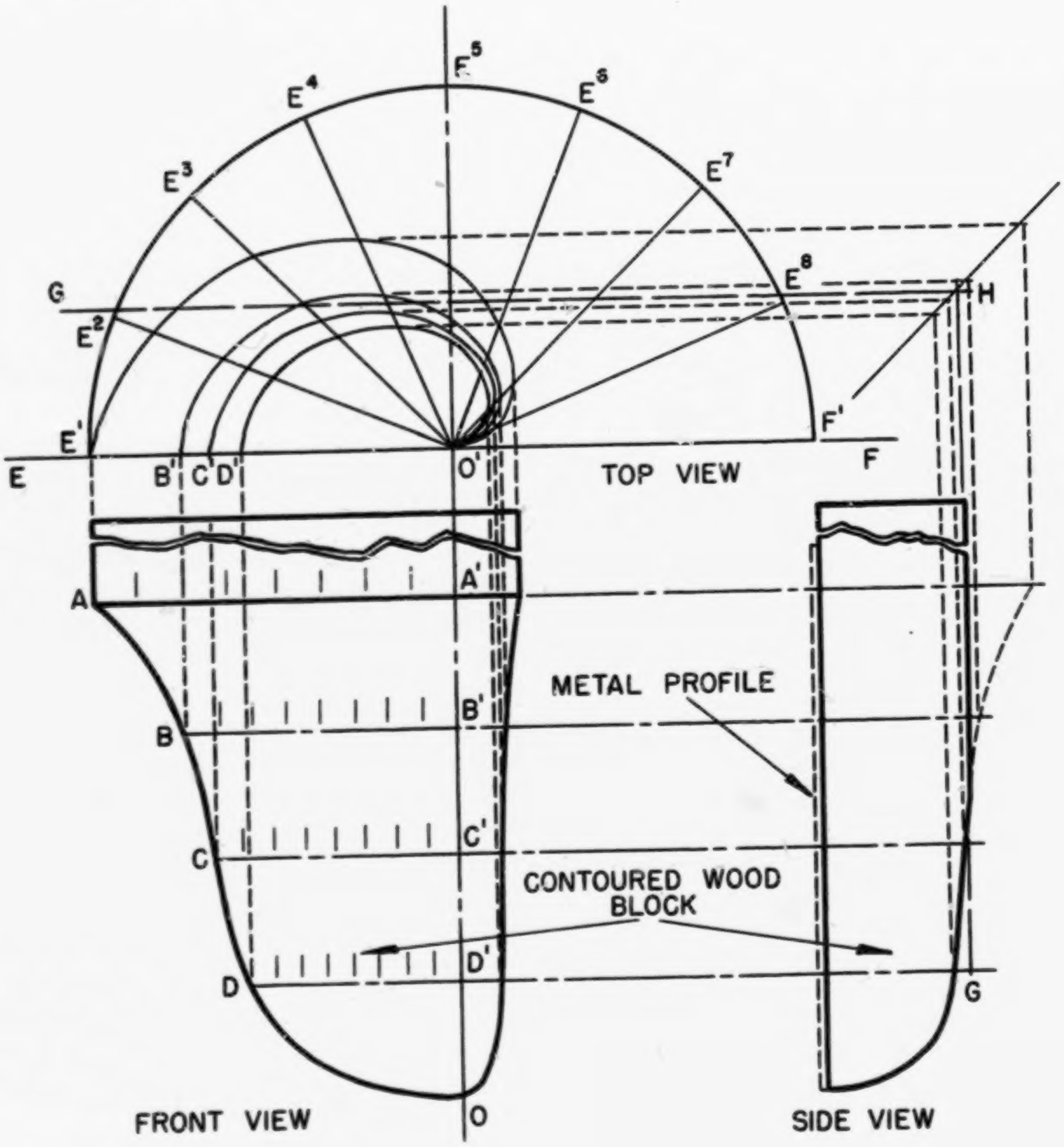
Jiggering Tool

1 piece metal (zinc), $\frac{1}{16}$ inch thick x 2½ inches wide x 4¼ inches long
1 piece hardwood (maple), ¼ inch thick x 2 inches wide x 4¼ inches long
1 piece hardwood (maple), ½ inch thick x 2 inches wide x 4¼ inches long
1 piece hardwood (maple), ⅝ inch thick x 2½ inches wide x 8 inches long
4 brass wood screws, No. 8 x 1¼ inches long, round head
Waterproof seal and finish

CONTOURED HOLLOW WARE TOOL

The contoured hollow ware tool is designed for shaping of clay on the potter's wheel automatically, with one single operation. Where previously the clay had to be spread within the mold manually before the shaping tool was utilized, now, with the contoured tool, both spreading and shaping is done simultaneously. A detailed full scale design is required in making a contoured tool.

Working Drawing



E^5
E^4
E^6
E^3
E^7
G
E^8
H
E^2
F'
E'
E
B' C D'
O'
TOP VIEW
F
A'
A
METAL PROFILE
B'
B
C'
C
CONTOURED WOOD BLOCK
D'
D
G
FRONT VIEW
O
SIDE VIEW

A contoured tool design is developed as follows:

Draw full size front view of clay profile line AOA′. OA′ will become the index line of the finished tool. (See figure 1.)

Extend line OA′ to top of sheet.

Draw section lines AA′, BB′, CC′, DD′, perpendicular to the index or centerline. (See figure 2.)

Draw line EF, 2 inches above and parallel to line AA′, intersecting centerline at O′. Extend point A vertically to EF to point E′. (See figure 3.)

With point O′ as the center and E′O′ as the radius, draw semicircle E′F′. (See figure 4.)

Draw radians E′O′, E^{2}O′, E^{3}O′, E^{4}O′, E^{5}O′, E^{6}O′, E^{7}O′, E^{8}O′, F′O′, forming eight equal segments. (See figure 5.)

Project points B,C,D, vertically to line E′F′. (See figure 6.)

Divide AA′, BB′, CC′, DD′, each, into eight equal parts. (See figure 7.)

Plot and draw the contour of each section line (BB′, CC′, and DD′) as is illustrated here for section AA′. That is with O′ as the center, mark a point on

Radian O′E^8, $\frac{1}{8}$ length of AA′
Radian O′E^7, $\frac{2}{8}$ " " "
Radian O′E^6, $\frac{3}{8}$ " " "
Radian O′E^5, $\frac{4}{8}$ " " "
Radian O′E^4, $\frac{5}{8}$ " " "
Radian O′E^3, $\frac{6}{8}$ " " "
Radian O′E^2, $\frac{7}{8}$ " " "
Radian O′E′, $\frac{8}{8}$ " " "

The spiral curve made by connecting each of these points is the contour line of the tool at section AA′. (See figure 8.)

Complete shape of the full profile of the tool design by dropping necessary lines from the top to the front view. (See figure 9.)

Draw side view by projecting necessary lines from both top and front views. This completes the full-scale detailed design.

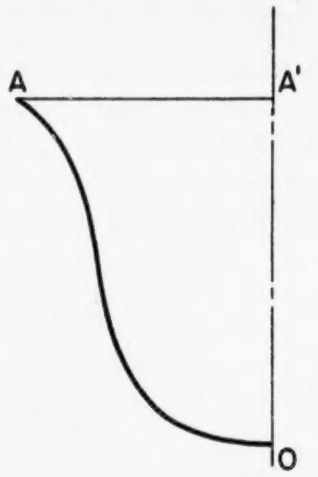


FIGURE 1

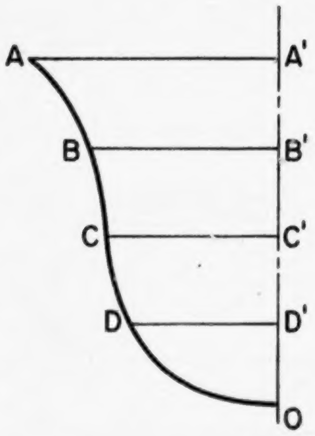


FIGURE 2

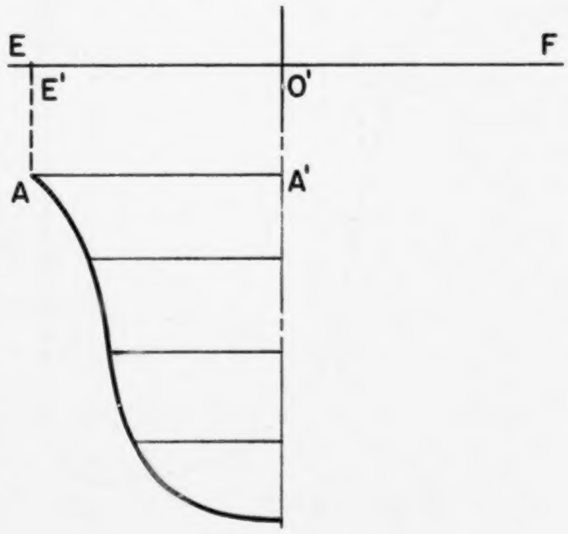


FIGURE 3

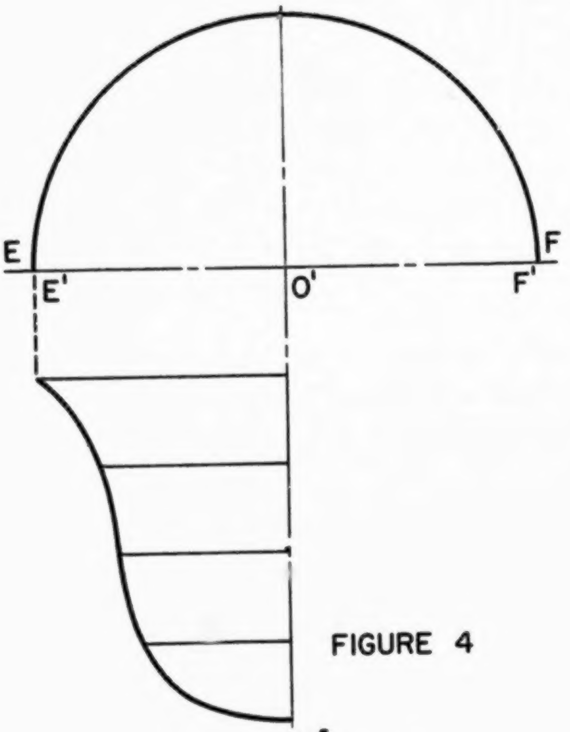


FIGURE 4

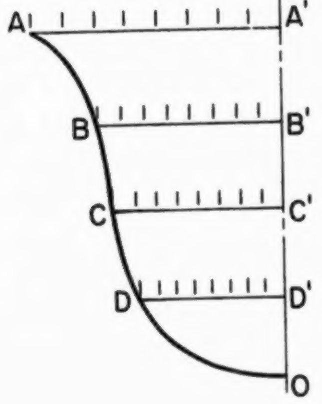


FIGURE 7

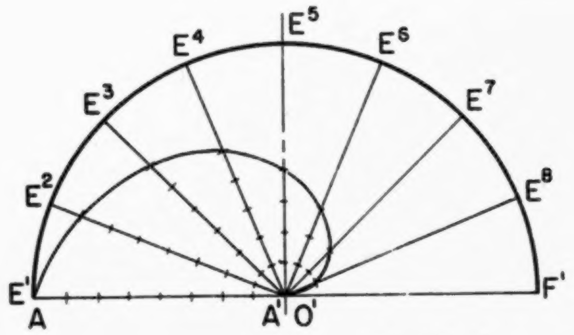

E⁵
E⁴
E⁶
E³
E⁷
E²
E⁸
E'
F'
A
A'
O'

FIGURE 8

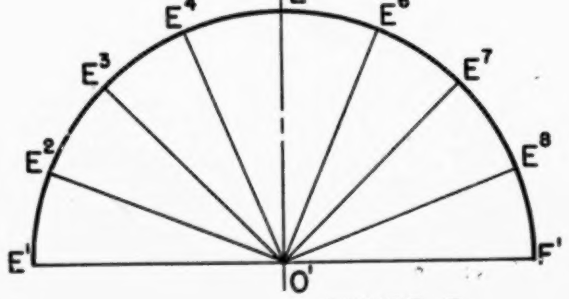

E⁵
E⁴
E⁶
E³
E⁷
E²
E⁸
E'
O'
F'

FIGURE 5

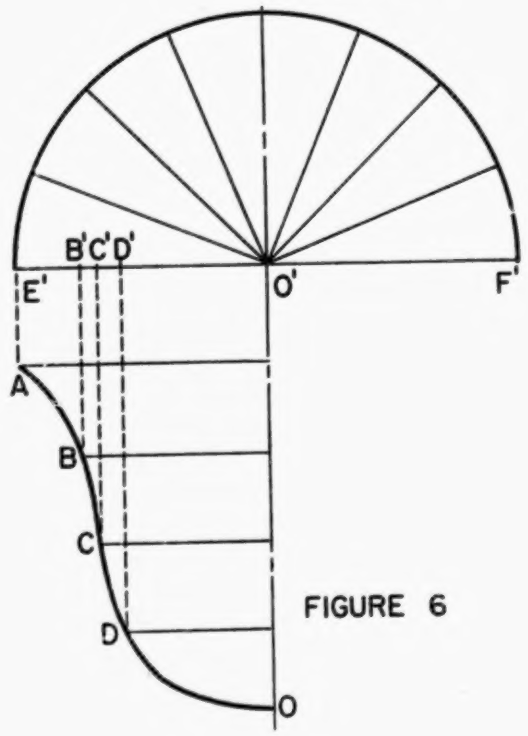

B'
C'
D'
E'
O'
F'
A
B
C
D
O

FIGURE 6

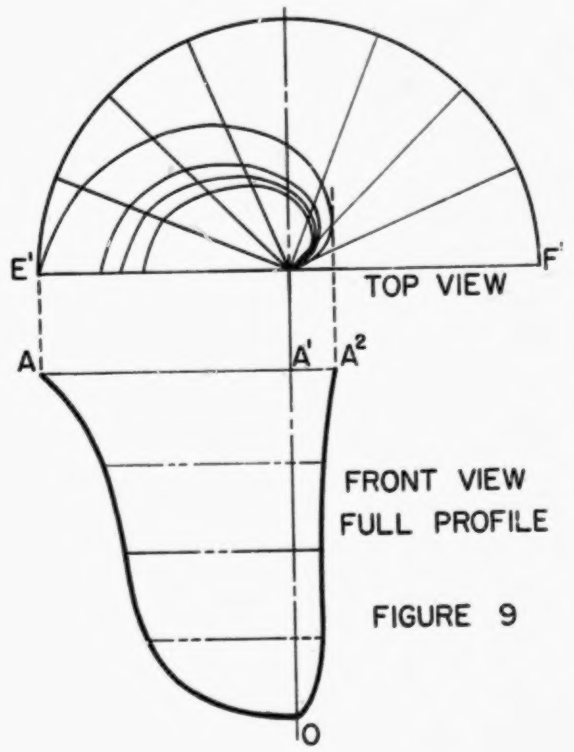

E'
F'
TOP VIEW
A
A'
A²
FRONT VIEW
FULL PROFILE
O

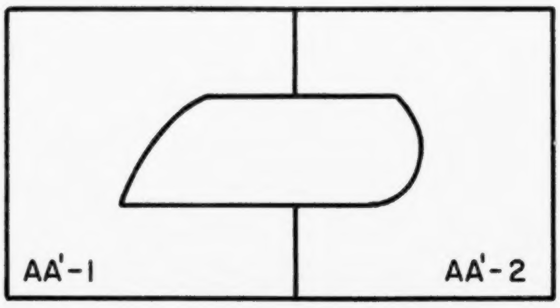
FIGURE 9

A contoured tool is made up of a shaped or contoured wood pressing surface and a metal profile plate. The profile plate, made of $\frac{1}{16}$- or $\frac{3}{32}$-inch sheet zinc, is cut and filed to shape indicated on design by points AOA′A. The contoured pressing surface is made from a block of close-grain wood at least 1½ inches thick. (In actual use, the full contour of the design is not utilized. Line GH, in top and side views of the working drawing limits the necessary thickness of the pressing surface of the tool.) The accurate shaping of the wood is accomplished by the use of two-piece templates, the shape of which is determined at each section line contour in top view. (See figure 10.)

Cut the wood block to rough shape using band or jig saw.

Trim and shape block, using chisels and gouges and the two-piece templates.

Fasten zinc profile plate to flat surface of wood section. Use glue and wood screws.



TEMPLATES FOR CROSS-SECTION AA'
FIGURE 10

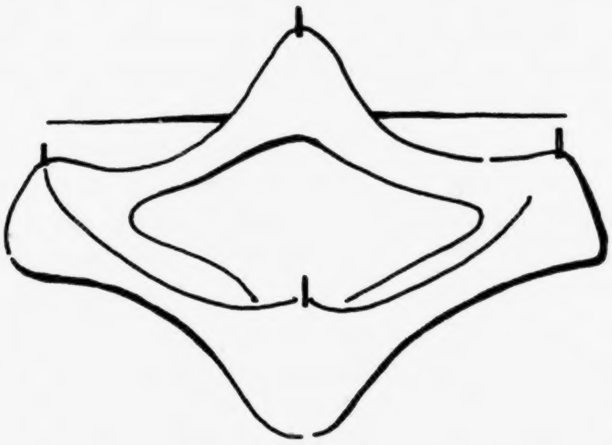
Final finishing is done with fine files and sandpaper. Wood surface should be treated with a sealer.

The finished edge of the metal profile plate OA′ is the index line which is used to locate the correct position of the tool on the jigger arm.

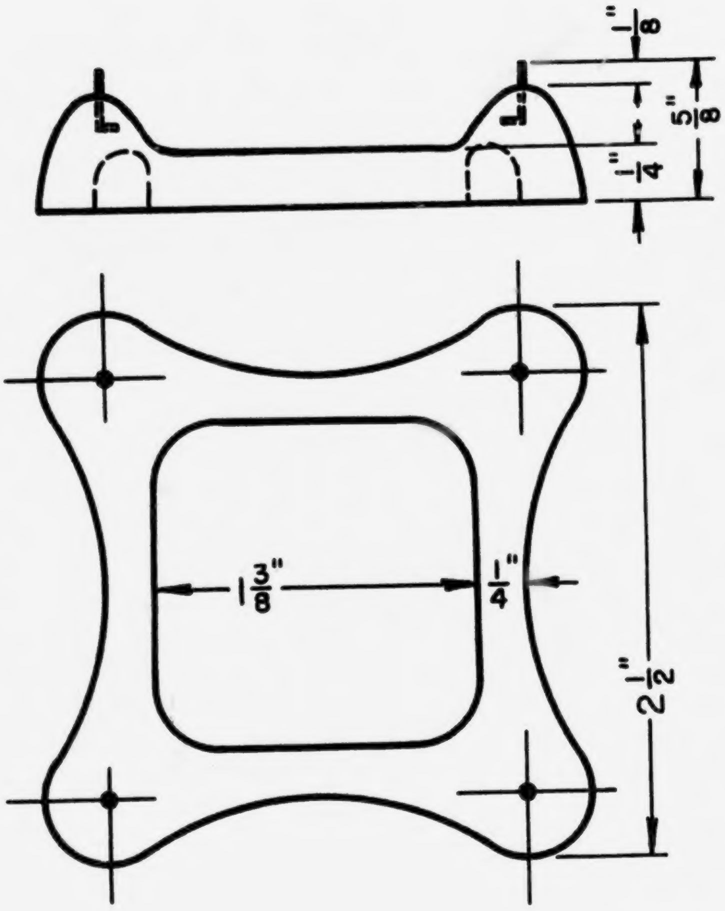
TOOLS AND EQUIPMENT

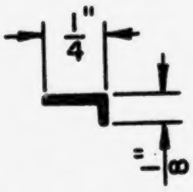
STILTS

Best results and more even distribution of heat are obtained when stilts are used during the firing process. Nichrome tip stilts can be made to fit almost any shape or size ware. A case mold can be made so that a number of identical molds can be produced.



Working Drawing





TIP SIZE

Procedure

Develop pattern of shape and size stilt desired. Allow for shrinkage.

Develop model of stilt from clay. Do this on a smooth surface such as glass or Masonite.

Frame model with galvanized steel frame or cottle, allowing about ½-inch clearance on all sides. Cottle should be twice as deep as the mold being made. (See figures 1 and 2.)

Soap size all areas.

Mix and pour plaster into cavity. Fill only half full.

Remove cottle and clay model.

Place plaster mold in bottom half of cottle with its shaped surface up. (See figure 3.)

Size plaster and cottle; mix and pour plaster to fill the cottle. When plaster hardens it is the case mold.

Place this case mold in the bottom of the cottle, formed surface up, size, and pour four or five successive identical plaster molds from which stilts can be made. (See figure 4.)

Drill 1/16-inch holes in each of the four corners for holding the nichrome tips. Each tip is ⅜ inch long bent to "L" shape, long leg being ¼ inch. No. 22 nichrome wire will work satisfactorily.

Insert nichrome tips in hold before pouring slip. Right angle portion must point away from plaster mold.

Pour slip; do not drain. This is a solid casting.

Upon removing piece from mold, dry and bisque fire before using.

Recommended sizes of stilts are 1 inch, 1½ inches, 2½ inches, and 3 inches between points.

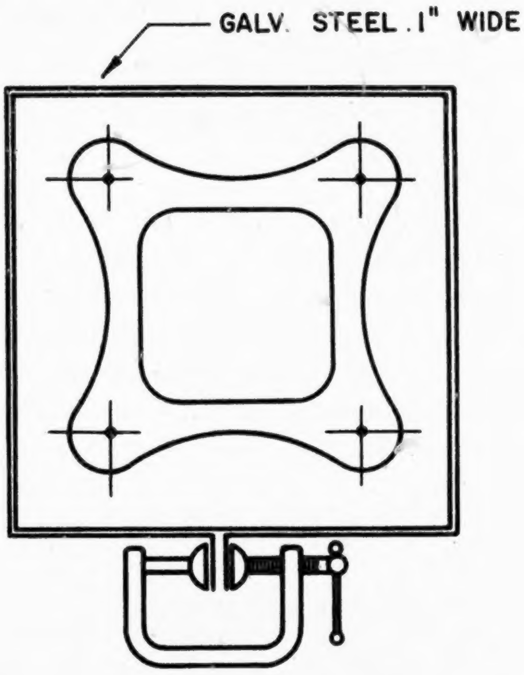


FIGURE 1

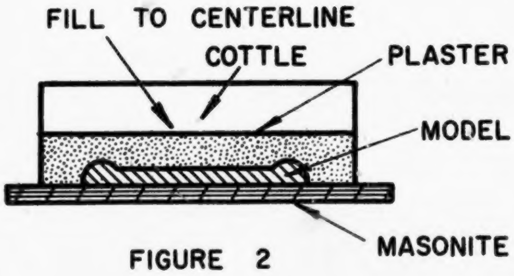


FIGURE 2

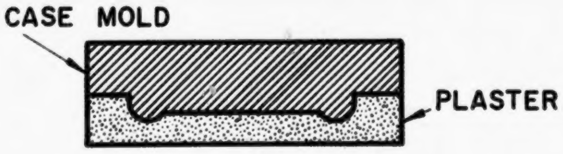


FIGURE 3

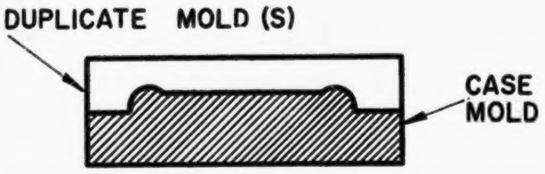


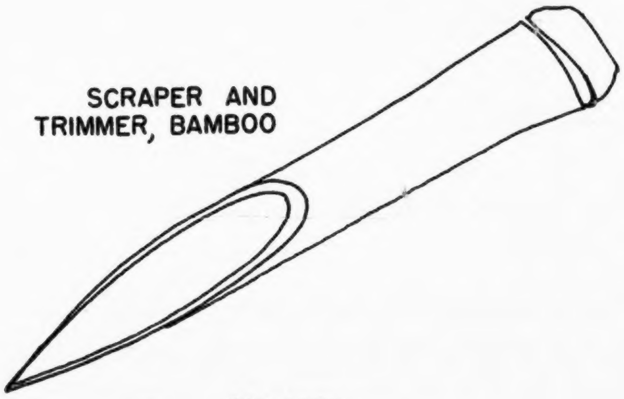
FIGURE 4

HAND TOOLS

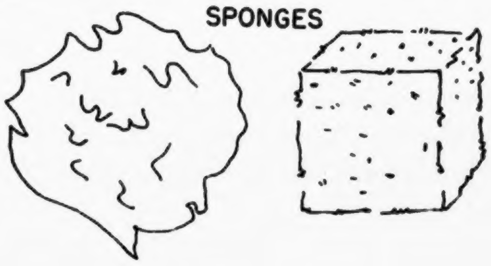
Almost any kind of ceramic tool can be purchased, but many potters prefer to make some to meet their own particular needs. Some "homemade" and other simple necessary tools are shown here.

Throwing Tools

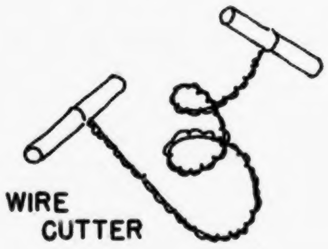
Scraper and trimmer (bamboo)—used for cleaning wheel head and rough trimming before cutting pot from wheel. Potter's knife or any sharpened stick will do the same job.



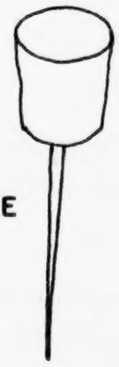
Sponges—for moistening work while throwing. Elephant ear sponge is preferred although any natural or synthetic sponge will work.



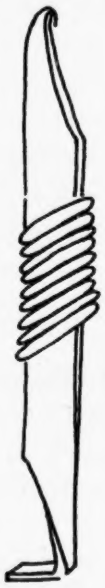
Wire cutter—to cut pots from wheel head. It is made of twisted soft wire fastened to short pieces of dowel rod.



Needle—employed in process of truing up top of cylinder during initial throwing steps. A cork makes a good handle for use when hands are wet.



Trimmer—used to trim leather-hard pot. Shape as needed. Worn hack saw blades with cord handles dipped in hot wax work well.



Plaster Tools

Jack knife—useful all-purpose tool.

Plaster turning tool—for cutting a profile on a revolving column of freshly set plaster.

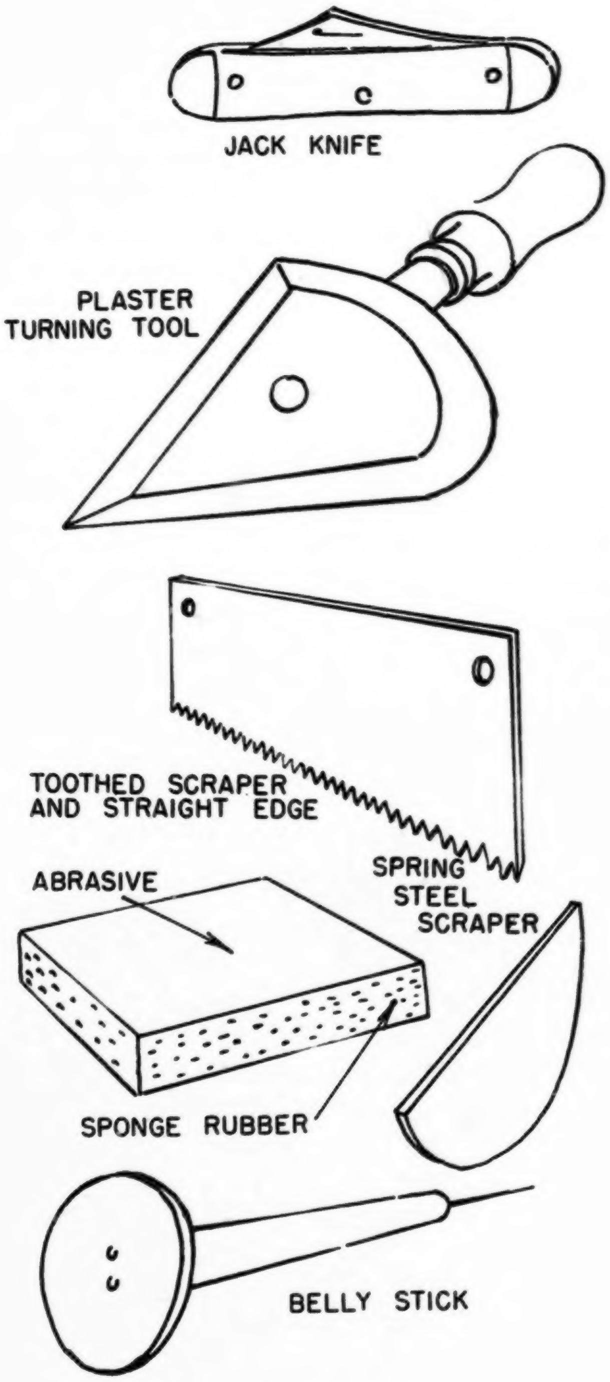
Toothed scraper and straight edge—used in mold making to obtain straight smooth surfaces. Toothed edge used to cut plaster quickly and uniformly.

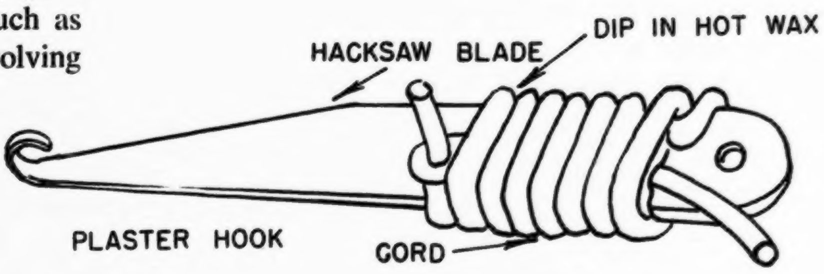
Abrasive sponge—invaluable for finishing plaster to a high degree. Conforms to involved contours and is easily cleaned (commercial item).

Spring steel scraper—used in turning plaster to remove exact amounts.

Belly stick—employed to support turning tools. Very flexible in locating cutting tools exactly regardless of piece being turned.

Plaster hook—one of a family of cutting tools designed for specific cutting purposes. Good for stationary work such as joggle cutting, as well as for revolving work.

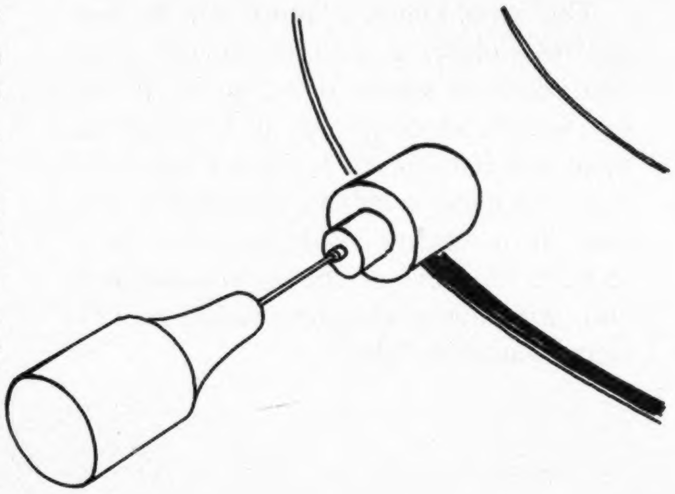

JACK KNIFE
PLASTER TURNING TOOL
TOOTHED SCRAPER AND STRAIGHT EDGE
ABRASIVE
SPRING STEEL SCRAPER
SPONGE RUBBER
BELLY STICK


HACKSAW BLADE
DIP IN HOT WAX
PLASTER HOOK
CORD

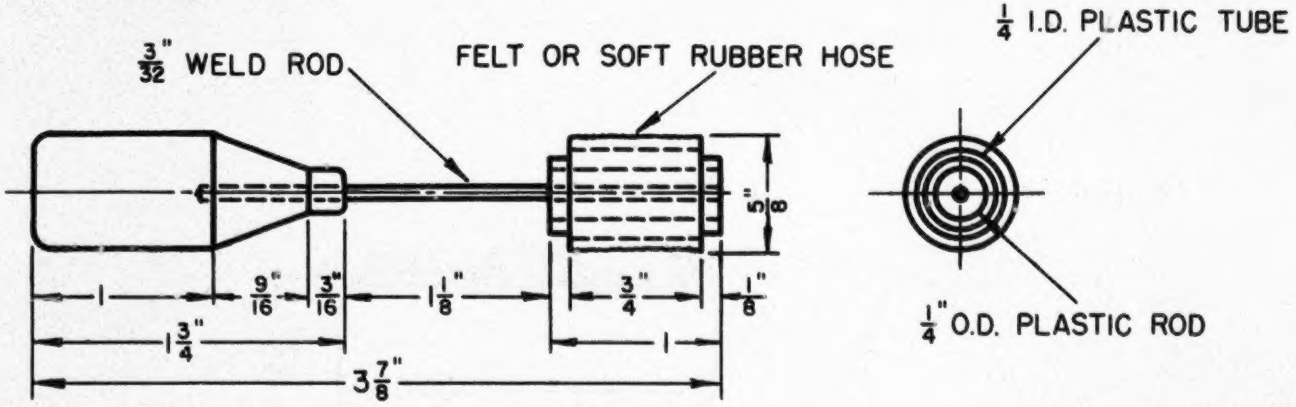
BANDING TOOL

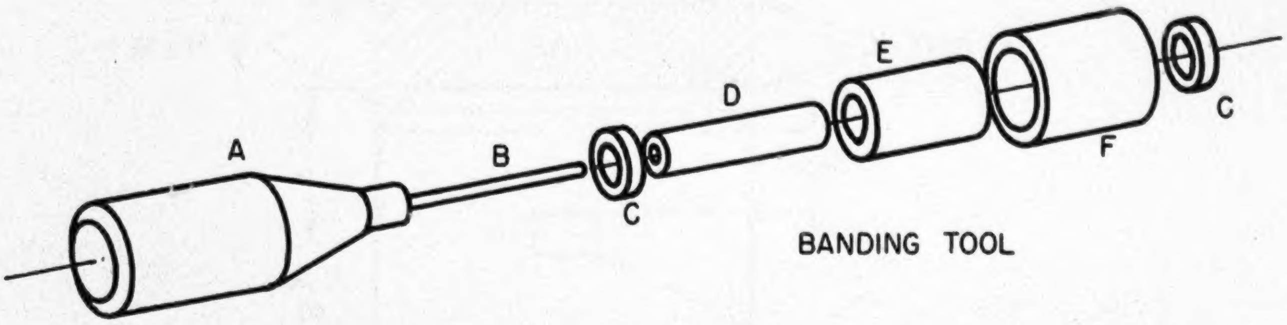
This is a very useful tool to have for banding fine to broad lines around the edge of a plate, cup, or saucer. It can be used for underglaze colors, glaze colors, overglaze, and lustres.

The color is placed on a pallet and picked up on the roller by rolling back and forth. The article to be banded is centered on a bench whirler and rotated. The roller is brought in contact with the surface of the piece as it revolves two or three times. This insures good coverage.



Working Drawing





BANDING TOOL

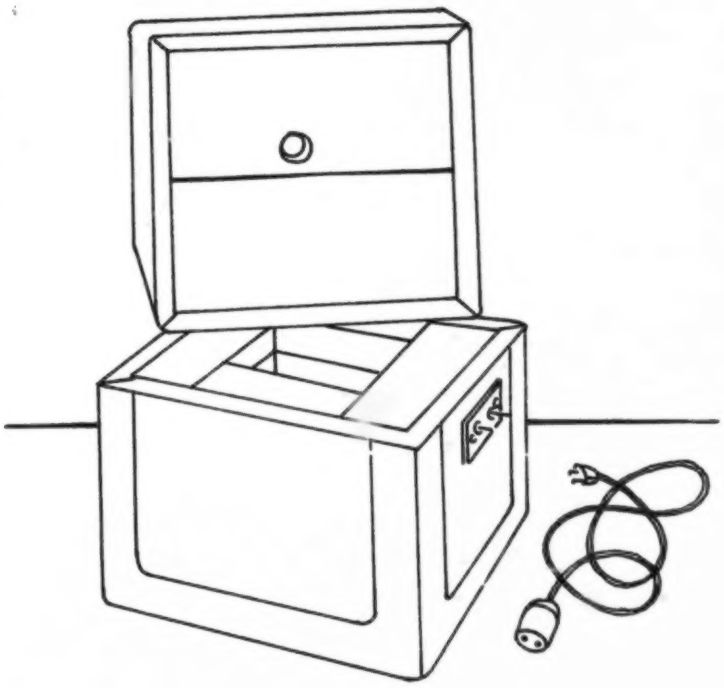
In making this tool, handle A and piece D are press fit on the stem B. Piece E slips over D and is held in place by collars C which are press fit over each end of D.

Bill of Material

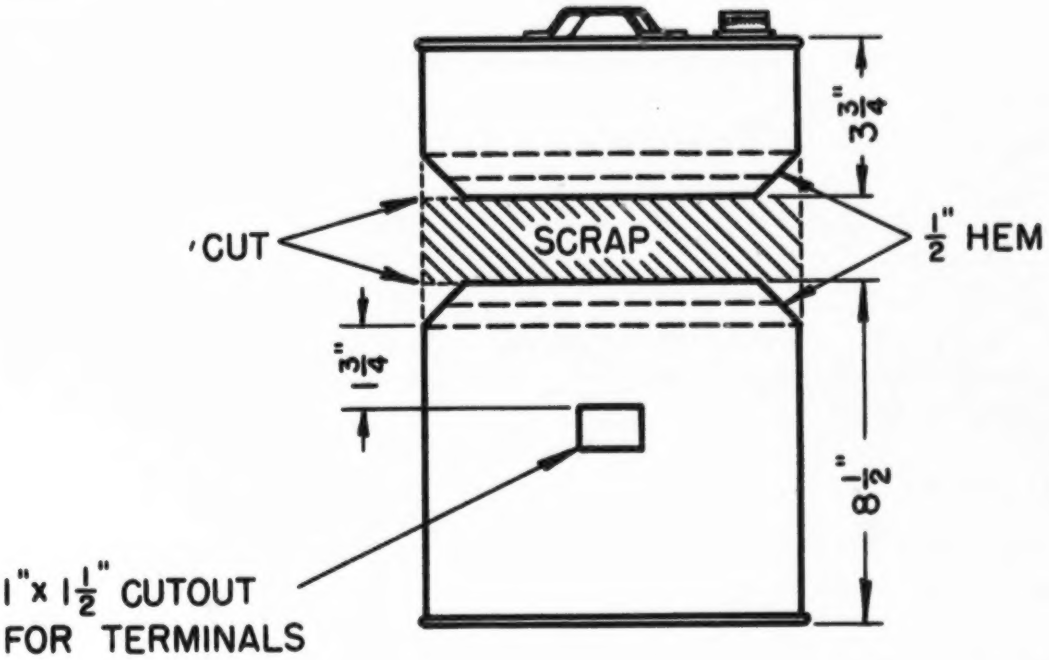
1 Wood dowel, ⅝-inch diameter x 1¾ inches long, A
1 Welding rod, 3/32-inch diameter x 3 inches long, B
2 Pieces Plexiglass, ⅜-inch diameter x ⅛ inch thick, C
1 Piece acrylic rod, ¼-inch diameter x 1 inch long, D
1 Piece acrylic rod, ⅜-inch diameter x ¾ inch long, E
1 Piece felt or soft rubber tubing, ¾ inch long to make snug fit over roller E, F

ELECTRIC TEST KILN

This small kiln is a "must" for the person who wishes to experiment with clays and glazes in school or at home. It will fire test pieces or jewelry in less than an hour and is designed for quick construction with easily available materials at low cost. It is always ready to serve as a stand-in for stove or hot plate in the shop and, with minor changes, makes an efficient enameling kiln.



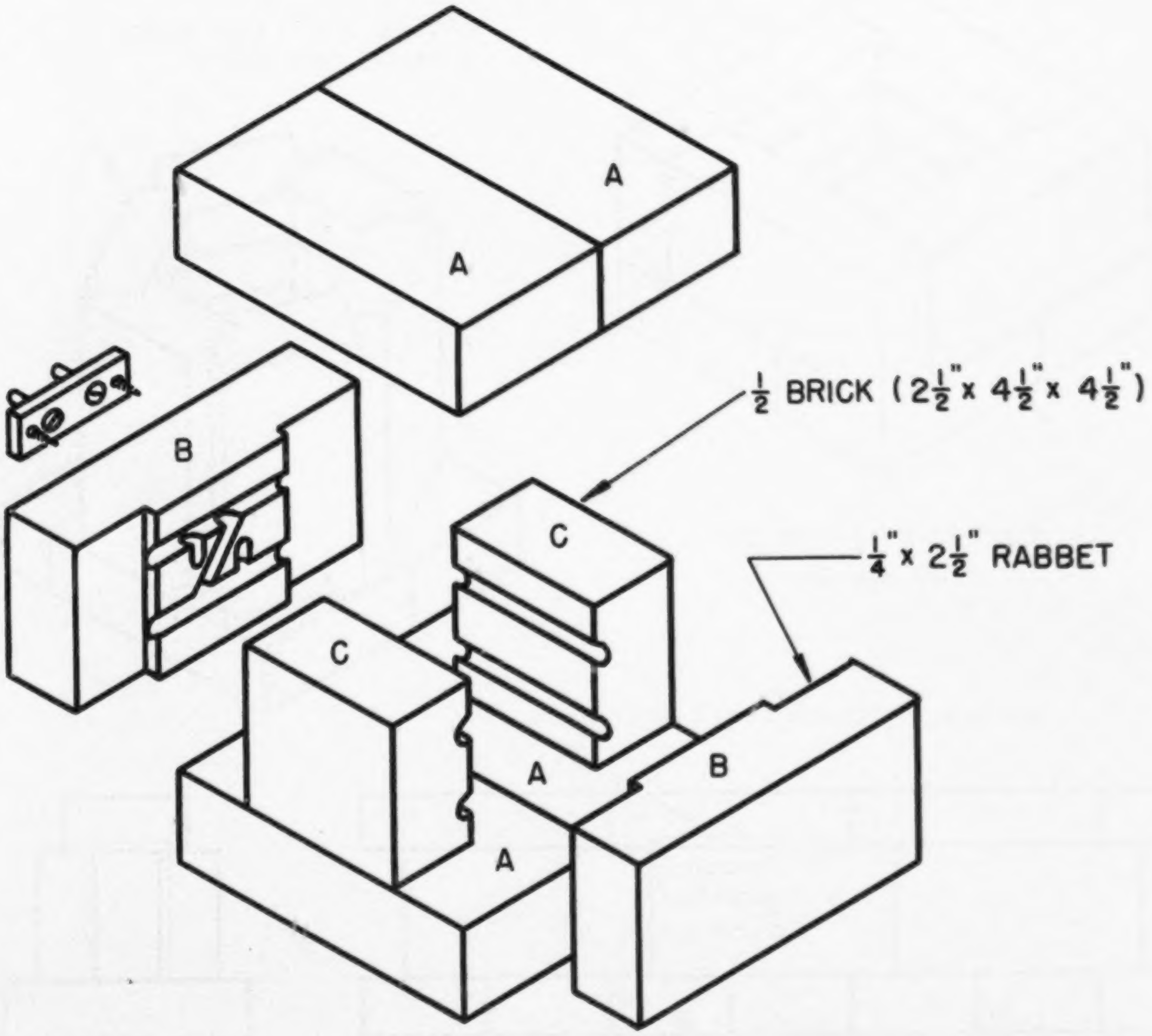
Working Drawing



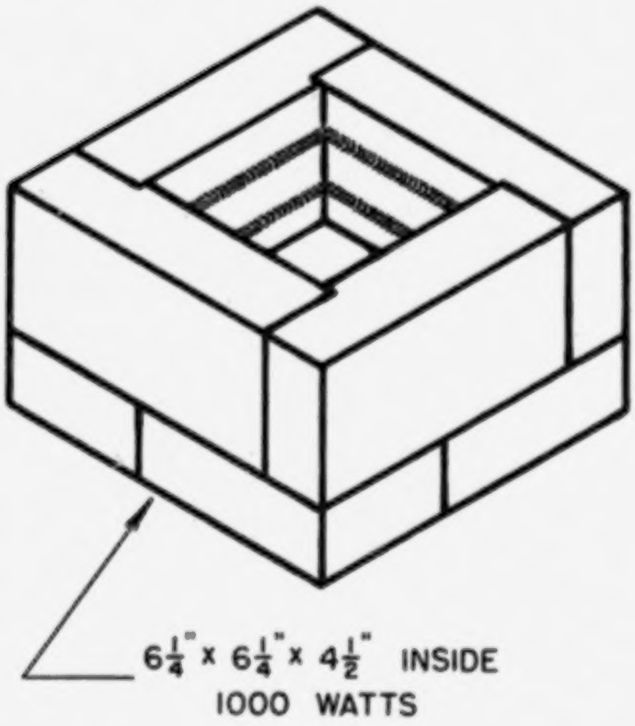
CUT
SCRAP
1/2" HEM
3 3/4"
1 3/4"
8 1/2"
1"x 1 1/2" CUTOUT FOR TERMINALS

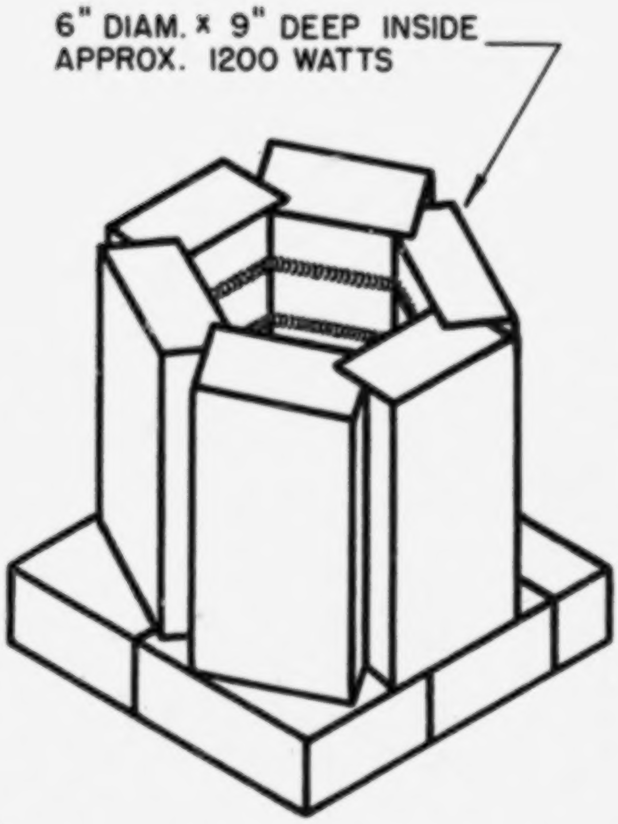
STANDARD SQUARE 5 GALLON CAN
(9" x 9" x 14")

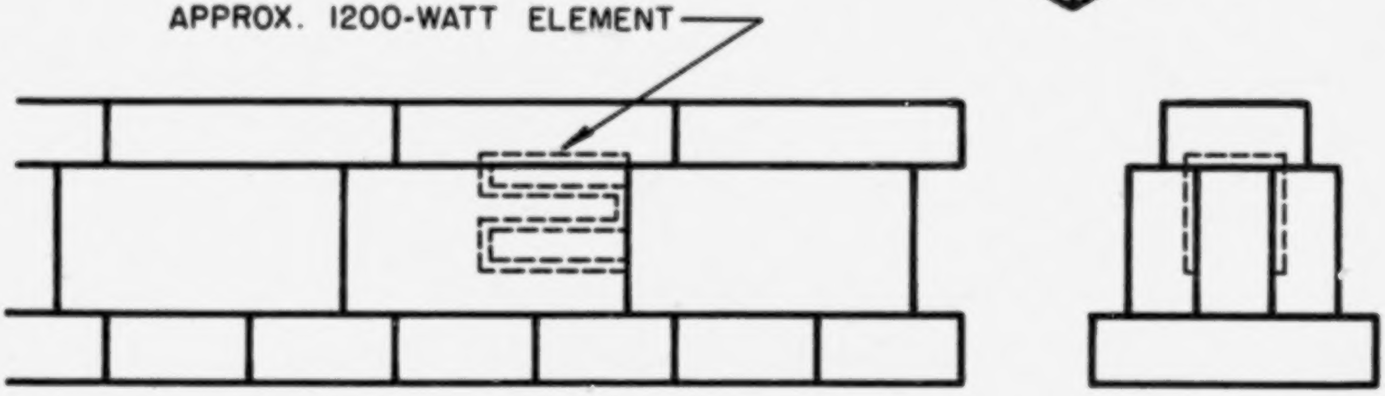
Working Drawing—Exploded View of Interior


A
A
½ BRICK (2½" x 4½" x 4½")
B
C
¼" x 2½" RABBET
C
A
B
A

Alternate Designs


6¼" x 6¼" x 4½" INSIDE
1000 WATTS


6" DIAM. x 9" DEEP INSIDE
APPROX. 1200 WATTS


APPROX. 1200-WATT ELEMENT

EXPERIMENTAL TUNNEL KILN

Research Activities

Using a pyrometer and clock, plot a time-temperature graph showing the rate of heat rise in the kiln.

Build a small gas test kiln using a Bunsen burner as the heat source.

Develop a working model of an electric tunnel kiln.

Design and construct a hinged door for this test kiln.

Convert the test kiln into a side-loading enameling kiln.

Experiment with bodies and glazes, firing them initially in the test kiln.

Procedure

Lay out cutting and folding lines on can, cut, and fold ½-inch hem with hand seamer.

Mark and cut middle brick (C) in half, cut rabbets in brick (B).

Lay out and cut element grooves, either with hacksaw or with homemade router in drill press. (See figure 1.)

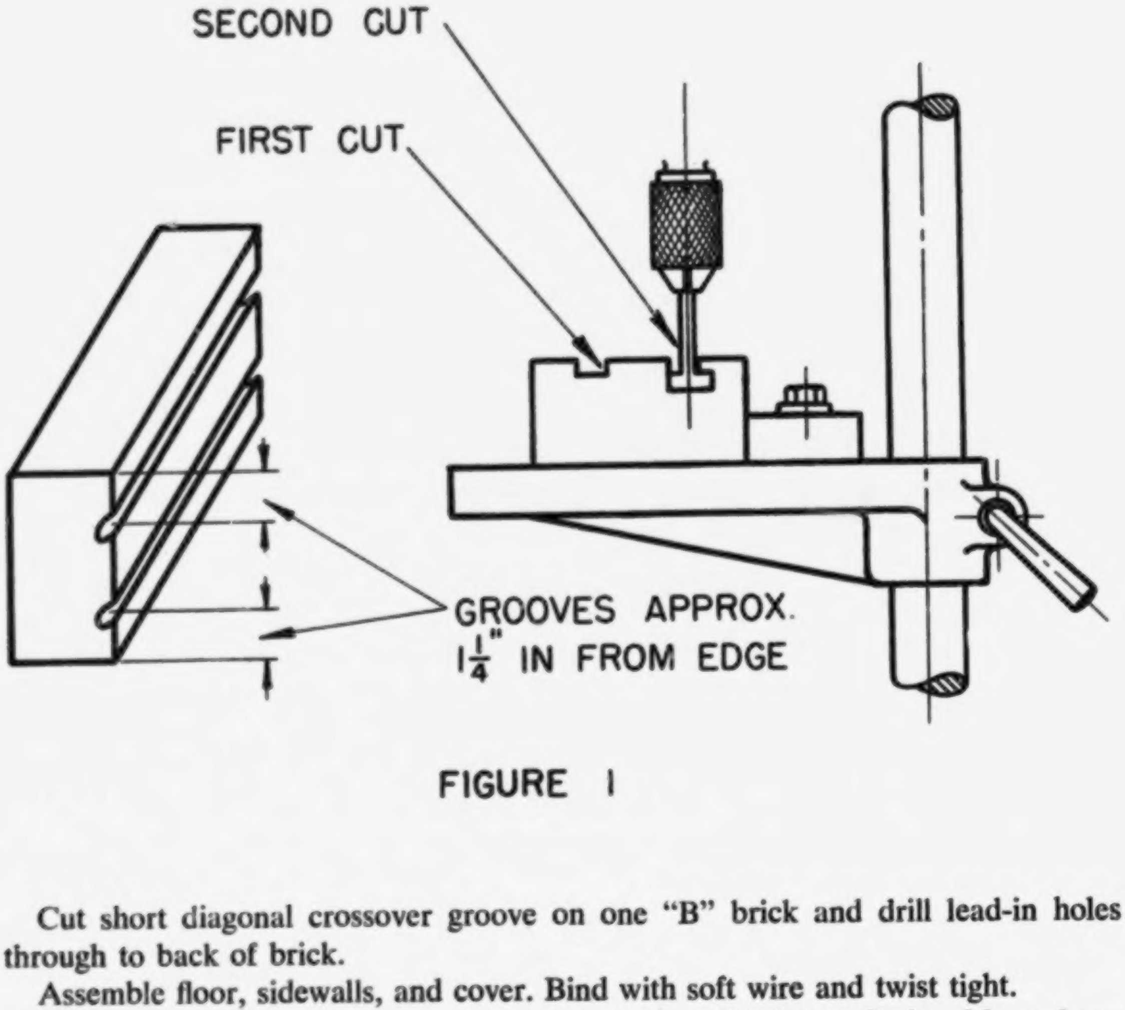


FIGURE 1

Cut short diagonal crossover groove on one "B" brick and drill lead-in holes through to back of brick.

Assemble floor, sidewalls, and cover. Bind with soft wire and twist tight.

Fit floor and sidewalls into can, trimming corners of brick to fit; bend hem down against brick. Repeat above operations on cover and bore peephole.

Stretch elements to fit total groove length, fit into grooves and project ends through leadout holes.

Fasten ends of elements to terminals and secure Transite panel to kiln case with sheet metal screws.

Check elements and connections and test fire.

Bill of Material

7 Refractory brick, K20 insulating, 2½ inches thick x 4½ inches wide x 9 inches long
1 Heating element, 600 watt
1 can, 5-gallon, rectangular, 9 inches x 9 inches x 14 inches
1 Piece Transite, ¼ inch x 2 inches x 3 inches
4 Sheet metal screws, No. 6 x ½ inch long
2 Brass machine screws, No. 10-24 x 1½ inches long
4 Brass nuts, No. 10-24
1 Insulating brick, 1 inch x 1 inch x 3 inches
1 Piece heater cord lead wire, 3 feet long

Related Technical Information

Pyrometric Cones:

In any heating process it is necessary to know the temperature of the heated space in order to control or determine the change being wrought in the products being heated. In ceramics, unlike baking, it is not always possible to open the kiln and check the progress of the firing. There are three means of determining the temperature in a kiln (1) by means of an electrical device called a pyrometer which gives a direct reading of the temperature; (2) by the use of pyrometric cones, carefully compounded of clay and fluxes to soften and deform when a certain degree of heat is attained; and (3) by means of draw trials, which are small samples of clay or clay and glaze pulled from the kiln from time to time during the firing.

Of these three methods the simplest and least expensive is the use of pyrometric cones. Cones do not measure temperature alone but the effects of temperature and time. This combination of factors is what really effects changes in ceramic materials.

Reference to a standard cone chart will show the cones needed for the particular heat range employed. Cones are usually placed in sets of three (1) a warning cone, one cone lower than the intended firing, (2) the cone representative of the firing desired, and (3) a control cone, one cone higher than the particular firing.

Other topics to explore:

Temperature and Heat Measurement in Industry
Temperature Color Chart

Demonstrations

Cut fire brick.
Load a kiln.
Prepare pieces for test fire.
Place pyrometric cones.

Related Cultural Information

A History of Ceramic Kilns:

Pottery was first fired in an open fire and still is in many parts of the world. It was of necessity bisque ware, often marked by the vagaries of the flame. The first steps from the bonfire to the kiln came with the erection of walls, roof and the floor or grate upon which the ware was placed.

Other refinements followed, notably that of causing the hot combustion gases to reverse direction and flow downward through the ware before reaching the stack, thereby giving up more of their heat to the ware and resulting in more uniform and successful results.

At first, wood was used for fuel. As coal came into wider use it tended to replace wood, and was in turn supplanted by oil and gas. Now gas and electricity are the fuels predominately in use.

The periodic kiln (set, fire, cool, draw) is relatively inefficient. Many efforts were made to utilize the great amount of heat lost up the flue. In the first century (100 A.D.) the Chinese built connecting kilns up hillsides, these kilns were fired successively and the waste heat from one passed through, preheating the others. This type of kiln is referred to as a continuous chamber kiln and was not in use in Europe until the 19th century.

Kiln development has apparently slowed down with the advent of the tunnel kiln. This is one in which the ware instead of the fire moves and the operations of setting, drying, preheating, firing, cooling, and drawing occur simultaneously at various points along the length of the kiln. These kilns are both straight and circular in shape and are in use in most potteries today.

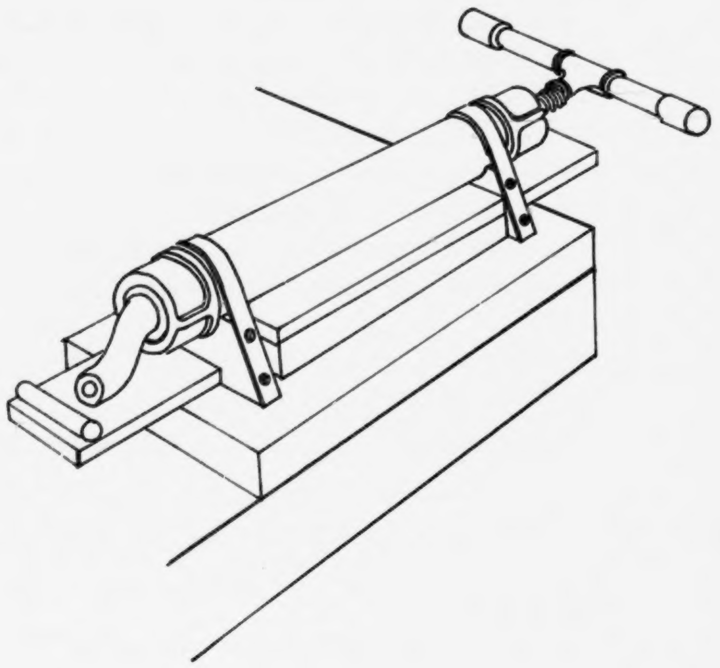
Other topics to explore:

Employment Opportunities in Ceramic Industries
The Ceramics Industry in New York State

References

Horne, R. H. *Ceramics for the Potter*. Chapter 16
Norton, F. H. *The Elements of Ceramics*. Chapter 16

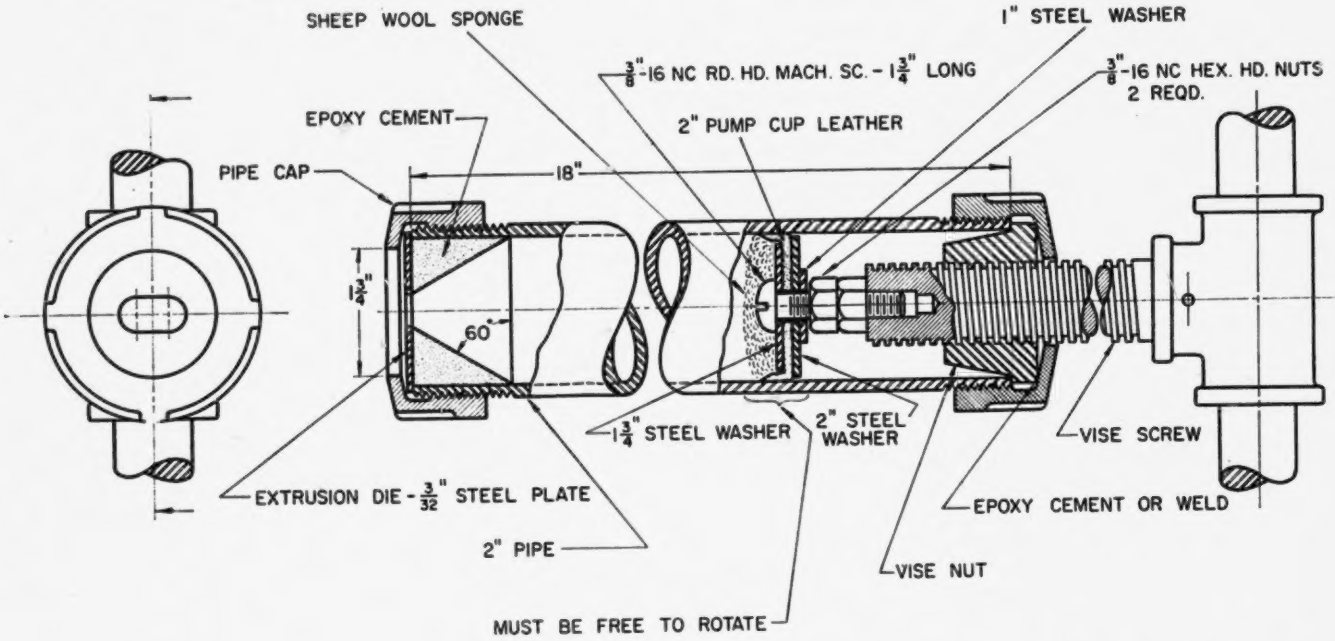
EXTRUSION PRESS



Vast quantities of structural clay products are produced industrially by forcing a column of stiff plastic clay through a specially shaped orifice or die. This process is referred to as extrusion and accounts for the production of a large percentage of structural clay shapes such as: brick, hollow wall tile, flue pipe, drain tile and sewer pipe.

The principle involved can easily be demonstrated by means of the simple hand-operated press pictured here. Its construction detail is shown in the working drawing. Quantities of uniform accurate material can be extruded quickly. The shapes suggested by the dies in figure 1 are but a few of the possibilities; such as tile for mosaic work, scale brick for the modeling enthusiast, jewelry shapes for beads and bracelets, and stock for handles and coil work.

Working Drawing


SHEEP WOOL SPONGE
1" STEEL WASHER
3/8"-16 NC RD. HD. MACH. SC. - 1 3/4" LONG
3/8"-16 NC HEX. HD. NUTS 2 REQD.
EPOXY CEMENT
2" PUMP CUP LEATHER
PIPE CAP
18"
1 3/4"
60°
1 3/4" STEEL WASHER
2" STEEL WASHER
VISE SCREW
EXTRUSION DIE - 3/32" STEEL PLATE
EPOXY CEMENT OR WELD
2" PIPE
VISE NUT
MUST BE FREE TO ROTATE

HAND OPERATED EXTRUSION PRESS

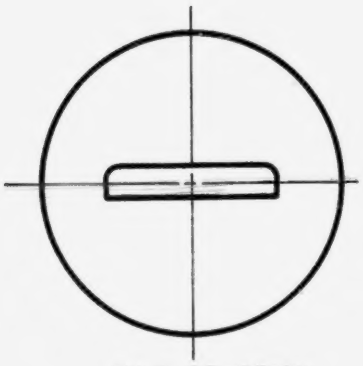
Procedure

Wedge clay to firm plastic consistency.
Form clay into slug slightly smaller than diameter of the tube.
Attach extrusion die to tube.
Insert slug in tube.
Assemble tube in press.
Extrude shapes—support clay as it comes from press.
Smooth surface of extrusion as necessary.

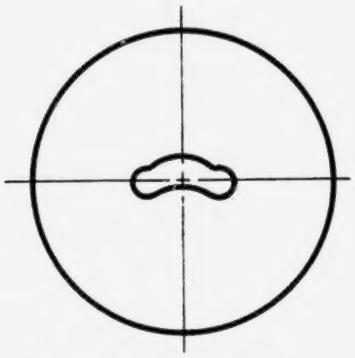
Bill of Material

1 Galvanized iron pipe, 2-inch diameter x 18 inches long
2 Galvanized iron caps, 2-inch diameter
1 Sheep wool sponge, 2-inch diameter
1 Steel washer, 1¾-inch diameter x ⅜-inch diameter hole
1 Pump cup leather, 2-inch diameter x ⅜-inch diameter hole
1 Steel washer, 2-inch diameter x ⅜-inch diameter hole
1 Steel washer, 1-inch diameter x ⅜-inch diameter hole
2 Hexagon machine nuts, ⅜-inch—16 NC
1 Round-head machine screw, ⅜-inch—16 NC x 1¾ inches long
1 Vise screw and nut assembly (approximately 1 inch—Acme Thread)
Several extrusion die plates

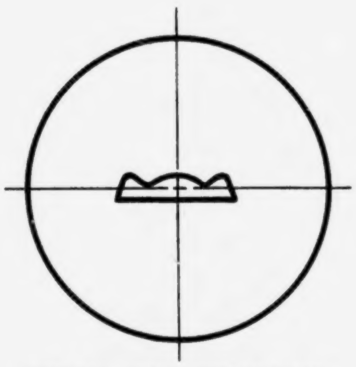
SUGGESTED EXTRUSION DIES



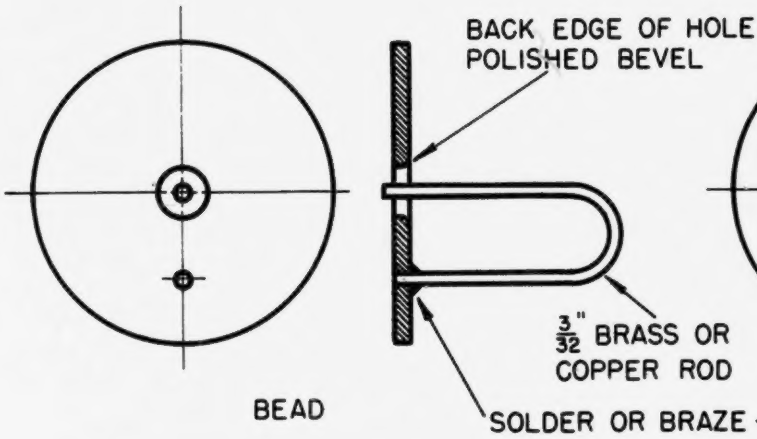
TILE OR BRICK



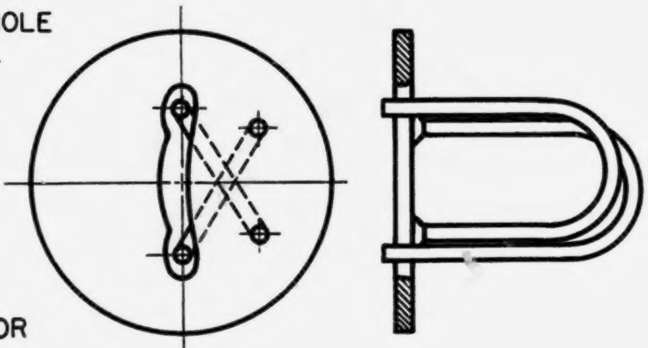
HANDLE STOCK



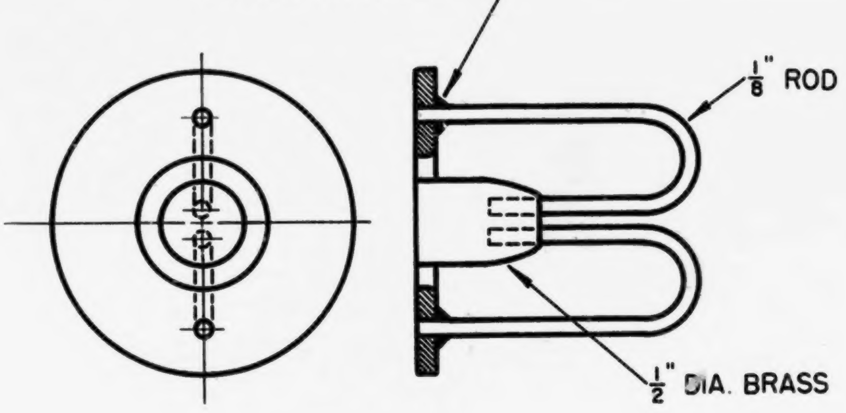
STOCK FOR SPRIGGING


BACK EDGE OF HOLE
POLISHED BEVEL
$\frac{3}{32}$" BRASS OR
COPPER ROD
SOLDER OR BRAZE

BEAD



BELT OR BRACELET


$\frac{1}{8}$" ROD
$\frac{1}{2}$" DIA. BRASS

TUBE OR PIPE

Alternate Design

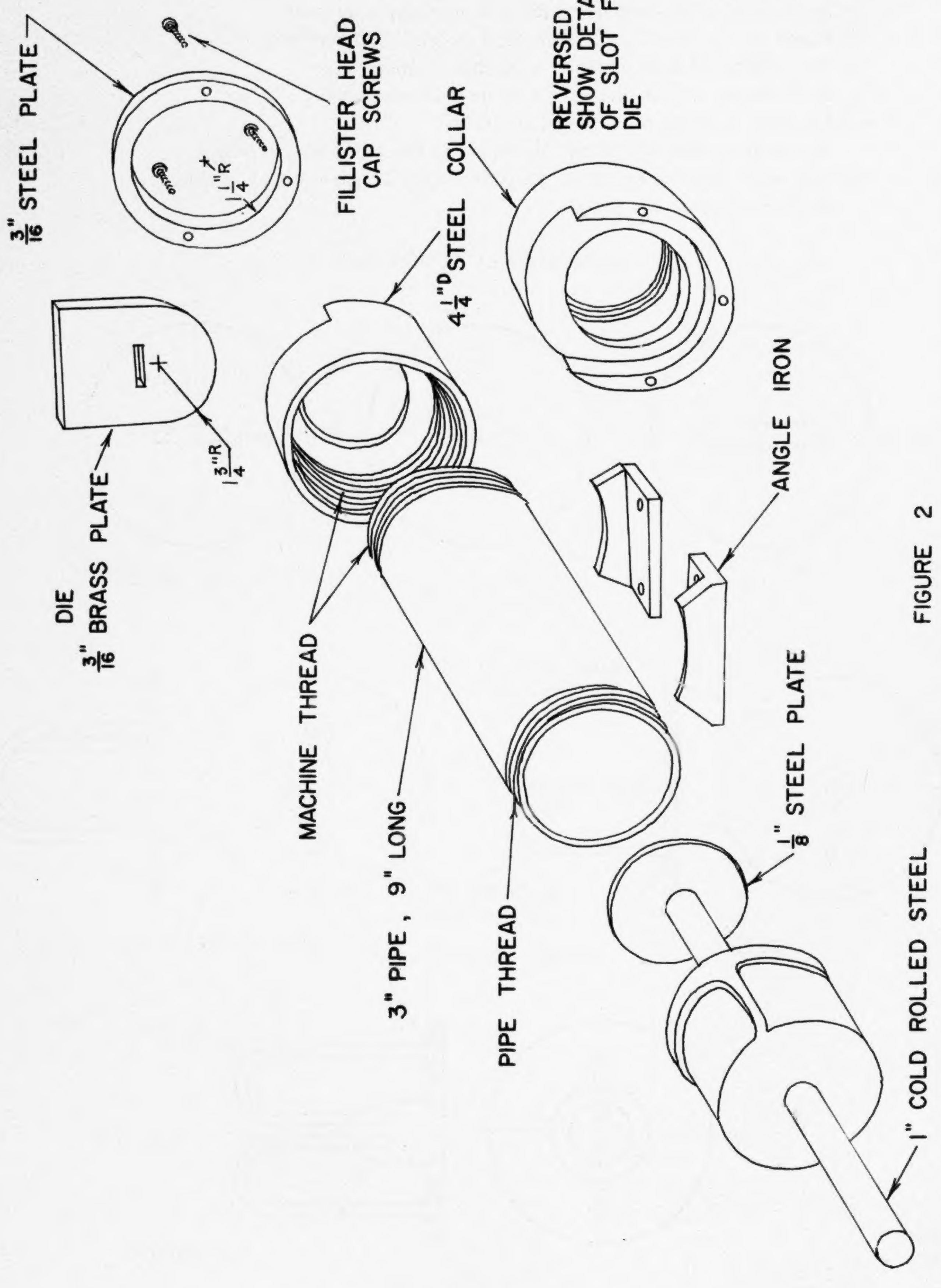

3/16" STEEL PLATE
FILLISTER HEAD CAP SCREWS
1 1/4" R
DIE
3/16" BRASS PLATE
1 3/4" R
4 1/4" D STEEL COLLAR
REVERSED TO SHOW DETAIL OF SLOT FOR DIE
MACHINE THREAD
3" PIPE , 9" LONG
PIPE THREAD
ANGLE IRON
1/8" STEEL PLATE
1" COLD ROLLED STEEL

FIGURE 2

Research Activities

Other types of extrusion presses are possible. Two that have been developed successfully in schools are pictured in figures 2, 3, 4 and 5. Figure 3 is the assembly of figure 2 with an additional suggestion of a method of getting clay into the press without having to remove the pipe cap and piston. Figure 4 shows this extrusion press lined up with a hydraulic jack and its pump.

A converted meat grinder with a pipe extension for compressing and de-airing the clay is pictured in figure 5.

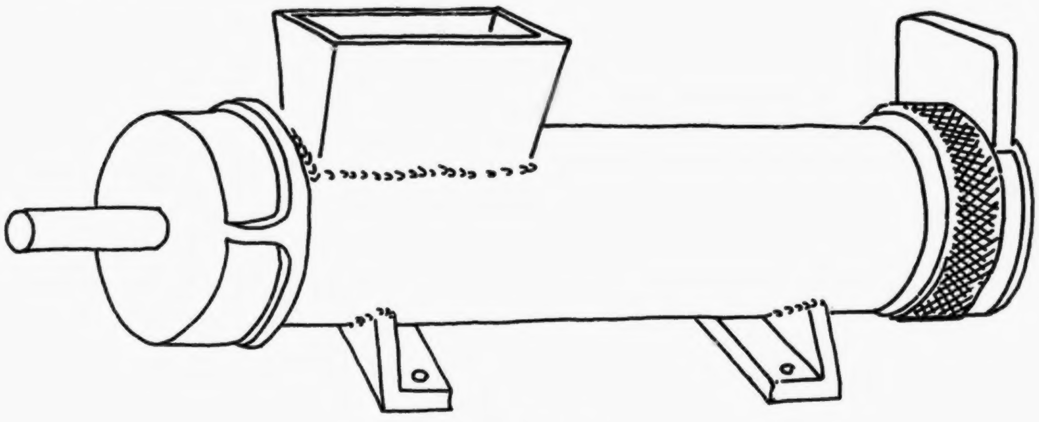


FIGURE 3.

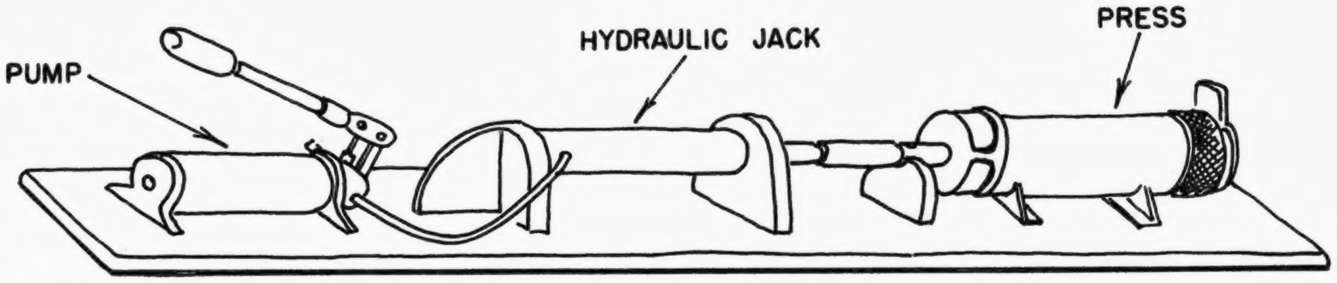


FIGURE 4.

Alternate Design

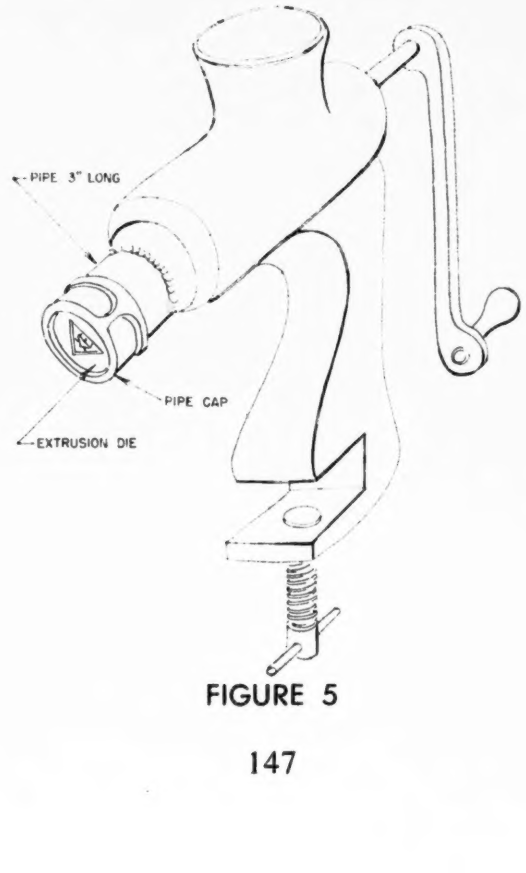


FIGURE 5

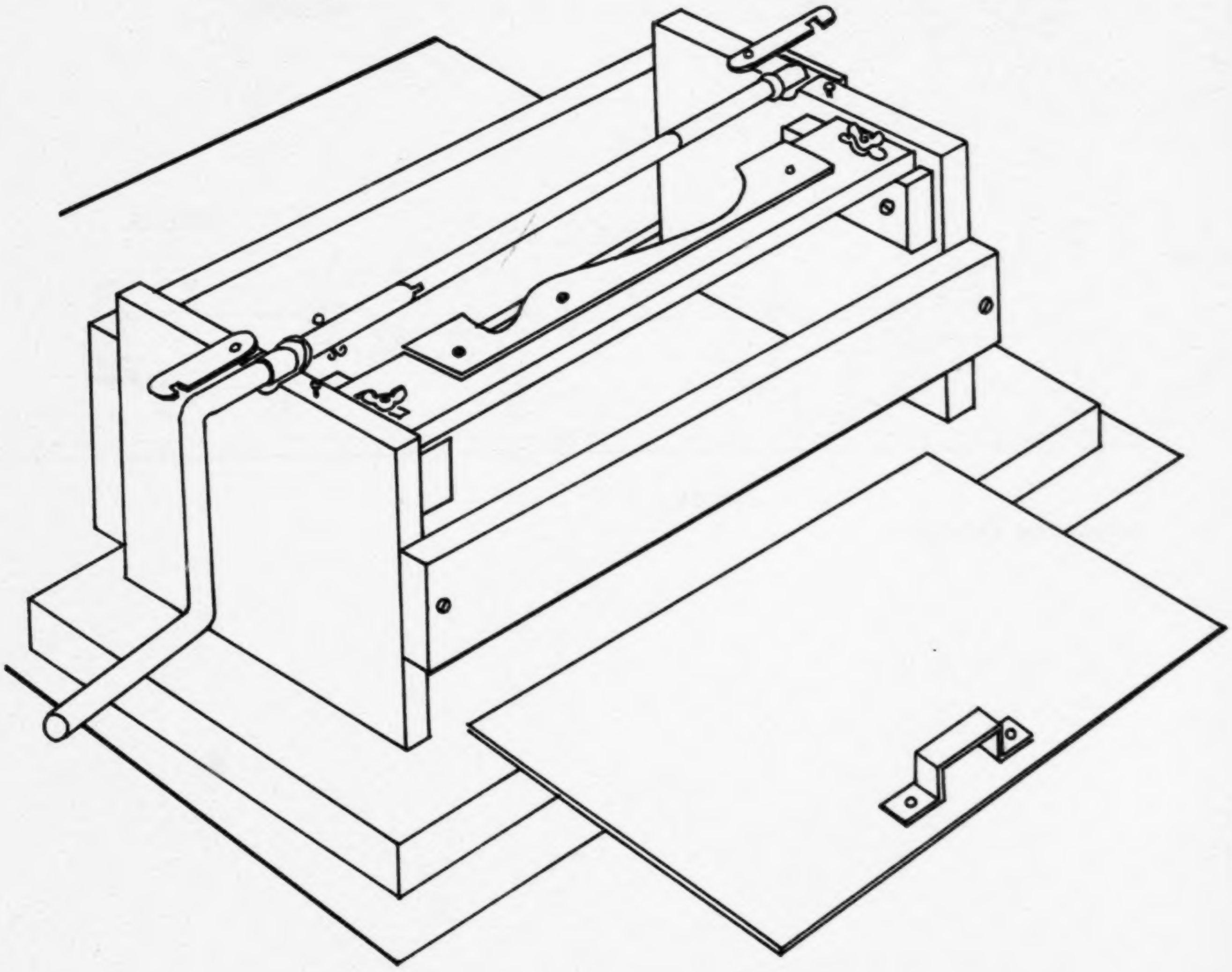
TURNING BOX

This device is used to produce cylindrical plaster models of original design from which a plaster mold may be made.

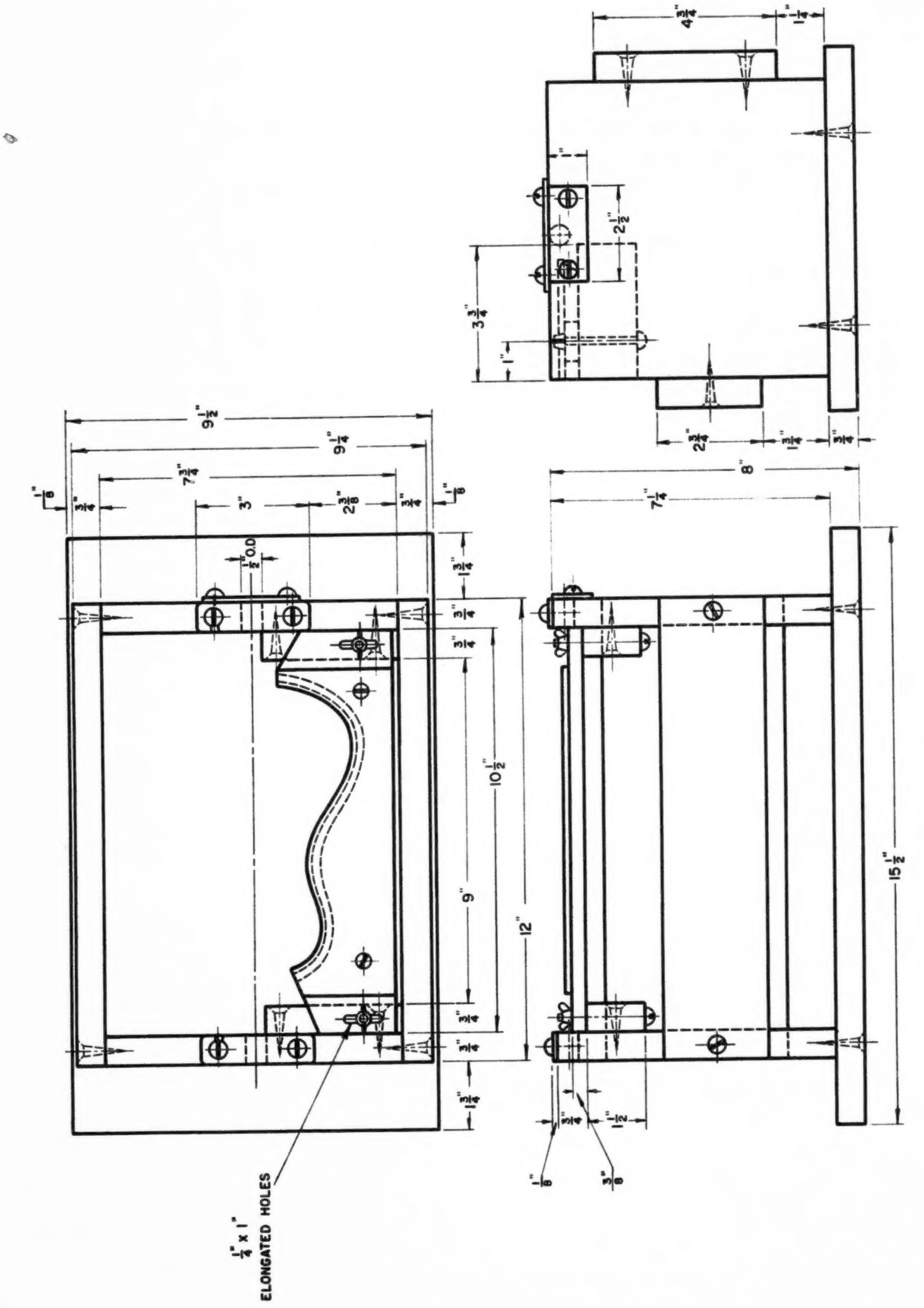
Plaster of paris is shaped on a base contour made up of cloth strips covering the turning shaft. The cloth provides a footing to which the plaster can adhere. The cylindrical model is built up and formed by rotating the plaster against a template.

The shaft and its brass tube sheath are designed to prevent end thrust while the model is being turned. The model is removed by twisting it and the tube off the shaft. The tubing is then removed by knocking or twisting it out of the model.

The template is rigidly fastened while the turning is in progress but may be easily adjusted and removed from the box without damage to the model.



Working Drawing


4 3/4"
1/4"
2 1/2"
3 3/4"
1"
2 3/4"
3/4"
9 1/2"
9 1/4"
7 3/4"
1/8"
3/4"
3"
2 3/8"
1/2" O.D
1 3/4"
10 1/2"
9"
12"
15 1/2"
8"
7 1/4"
1 1/2"
3/8"
1/4" x 1" ELONGATED HOLES

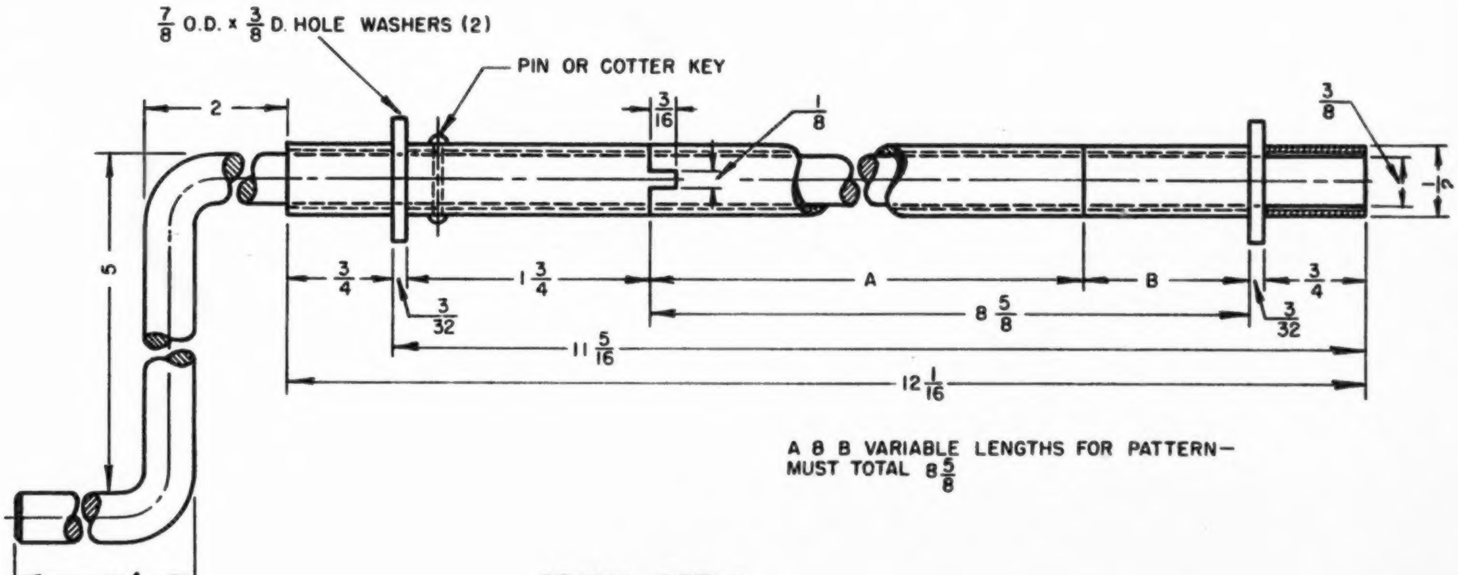
TURNING BOX

Bill of Material

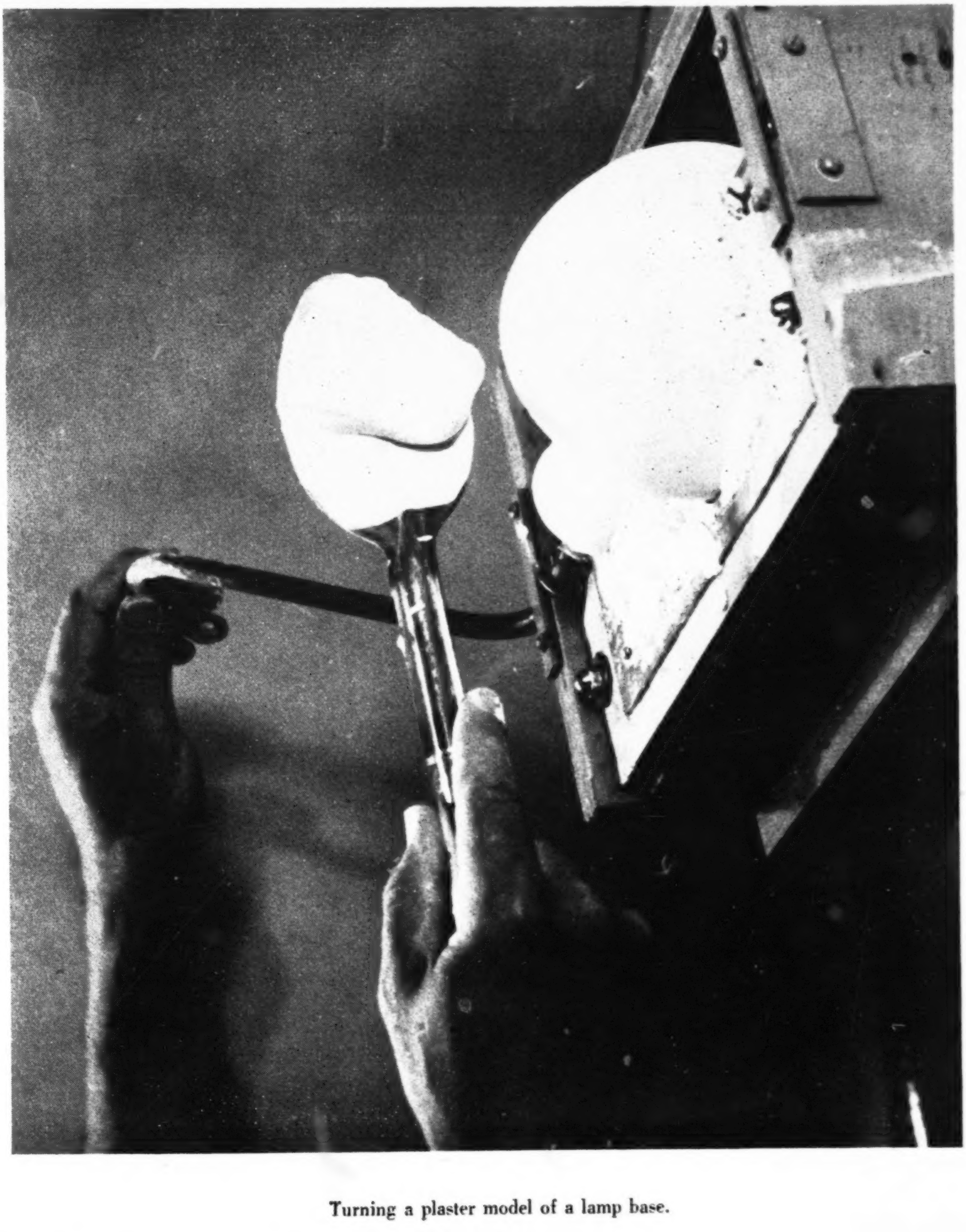
1 Piece waterproof plywood or maple, ¾ inch thick x 9½ inches wide x 15½ inches long, bottom
2 Pieces waterproof plywood or maple, ¾ inch thick x 7¼ inches wide x 7¾ inches long, ends
1 Piece waterproof plywood or maple, ¾ inch thick x 2¾ inches wide x 12 inches long, front side
1 Piece waterproof plywood or maple, ¾ inch thick x 4¾ inches wide x 12 inches long, back side
1 Piece waterproof plywood or maple, ⅜ inch thick x variable width for patterns x 10½ inches long, cutter backing
2 Pieces waterproof plywood or maple, ¾ inch thick x 1½ inches wide x 3¾ inches long, cutter board supports
1 Piece sheet zinc, 14 gage, 3½ inches x 8⅜ inches, cutter
14 Wood screws, F.H.B. No. 8, 1¼ inches long
6 Wood screws, R.H.B. No. 6, ¾ inch long
2 Hanger bolts, ¼-inch diameter, 2½ inches long with wing nuts
1 Sheet galvanized steel, 18 gage, 9½ inches x 10½ inches, clean out tray
1 Piece galvanized steel, 18 gage, ¼ inch wide x 5½ inches long, clean out tray handle
2 Pieces band iron, ⅛ inch thick x ⅜ inch wide x 3 inches long, swivel bearing straps
1 Piece band iron, ⅛ inch thick x ⅜ inch wide x 2½ inches long

Crank and Tube Assembly—

1 Piece cold rolled steel, ⅜-inch diameter x 24 inches long, crank
2 Washers, ⅜-inch diameter, No. 16
1 Piece brass tube, ½-inch diameter x ¾ inch long
1 Piece brass tube, ½-inch diameter x 1¹⁵⁄₁₆ inches long
1 Piece brass tube, ½-inch diameter x A
1 Piece brass tube, ½-inch diameter x B
Note: A and B are variable in length but must total 8⅝ inches
1 Piece brass tube, ½-inch diameter x ¾ inch long


7/8 O.D. x 3/8 D. HOLE WASHERS (2)
PIN OR COTTER KEY
2
3/16
1/8
3/8
1/2
5
3/4
1 3/4
A
B
3/4
3/32
8 5/8
3/32
11 5/16
12 1/16
4
A & B VARIABLE LENGTHS FOR PATTERN— MUST TOTAL 8 5/8

CRANK DETAIL

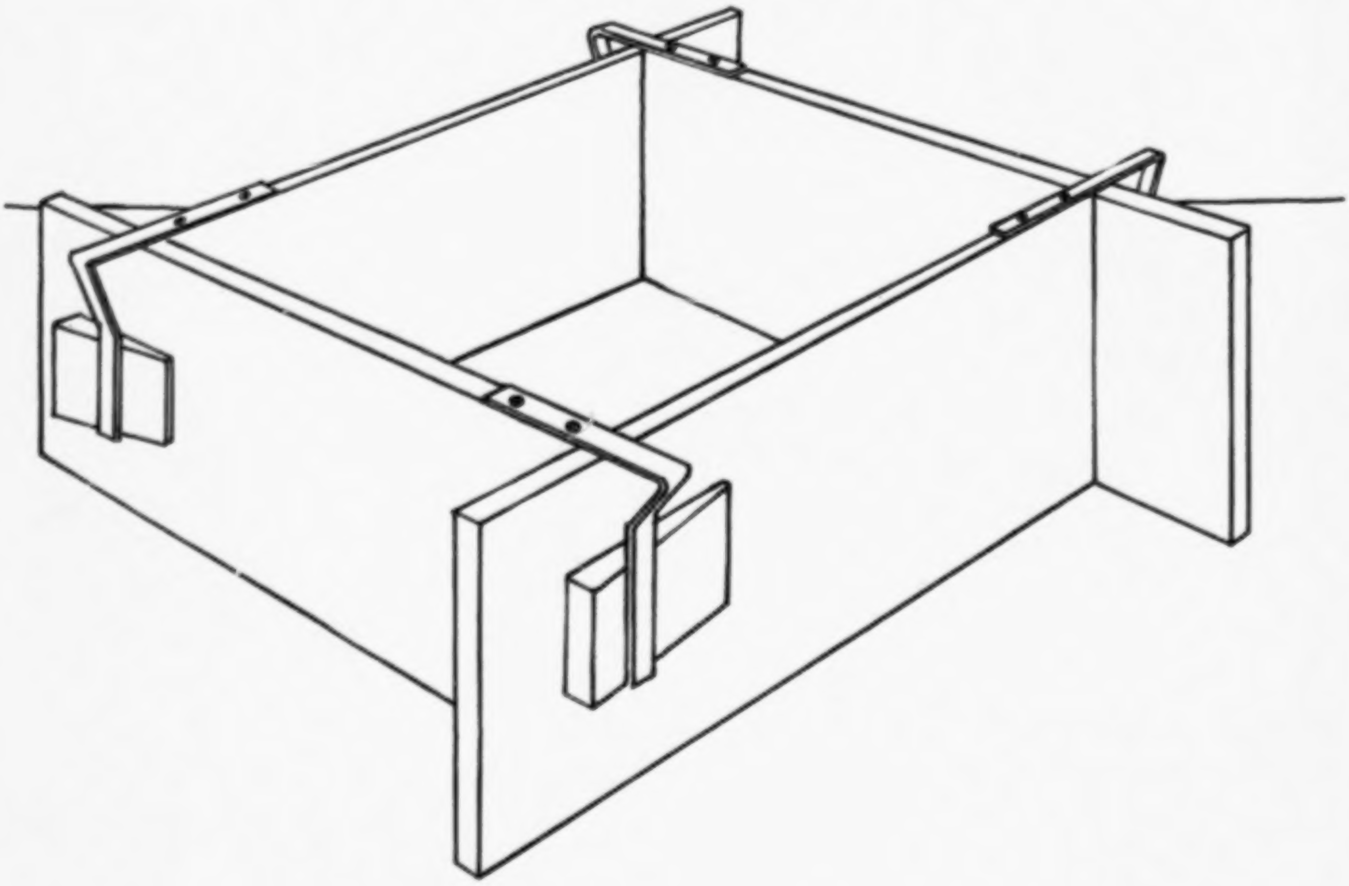


Turning a plaster model of a lamp base.

ADJUSTABLE COTTLE

The production of multiple-piece plaster molds can be improved with an adjustable cottle made up of four plywood walls, fitted with spring clamps and locked in place by easily handled wedges. Where large numbers of molds are made, several sizes of the illustrated design can be assembled to facilitate the production of any size mold desired.

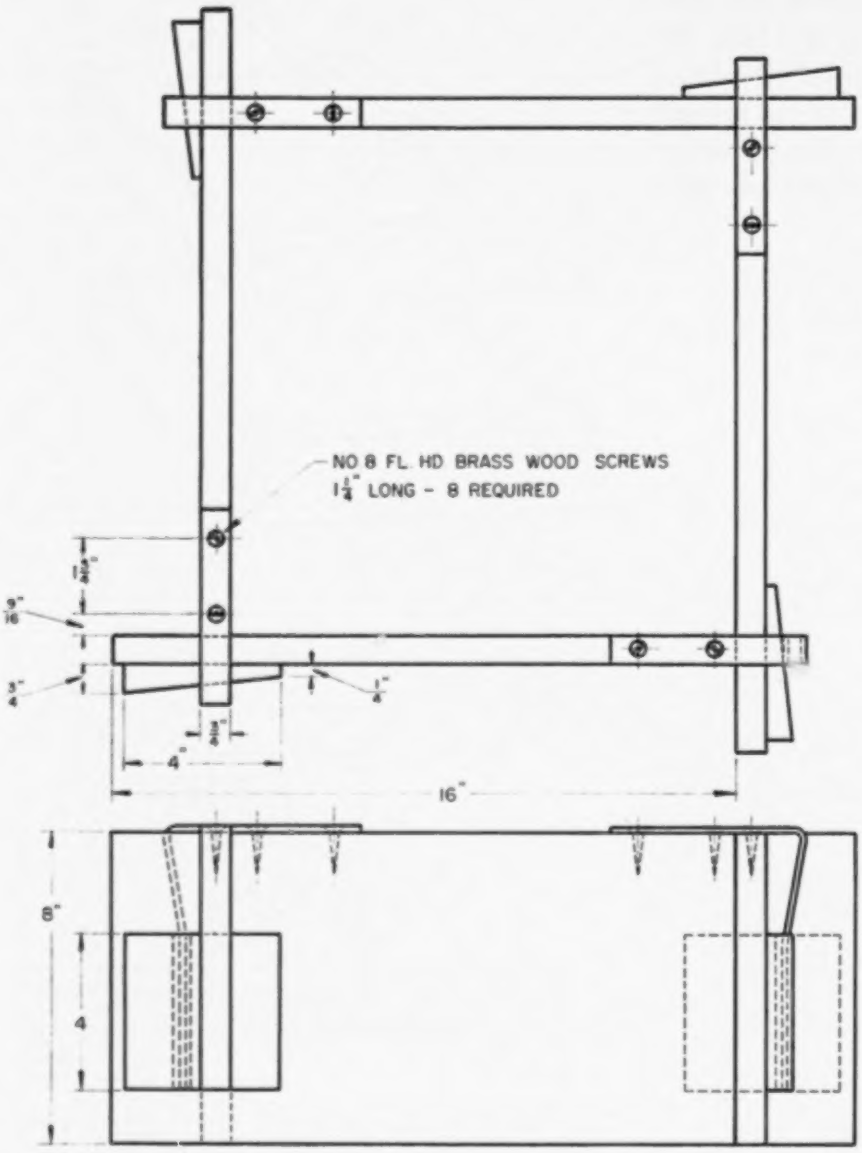
In the model illustrated, molds 3 inches x 3 inches x 8 inches to 15 inches x 15 inches x 8 inches can be produced.

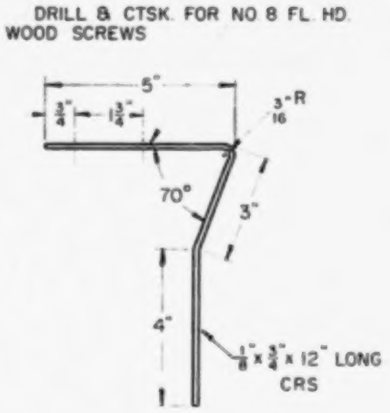


Working Drawing
See next page

Bill of Material
4 Pieces ¾-inch external fir plywood, 8 inches x 16 inches
4 Wedges, hardwood, 1 inch x 4 inches x 4 inches
4 Pieces cold rolled steel, ⅛ inch x ¾ inch x 12 inches
8 Wood screws, No. 8 x 1¼ inches, flat head

Working Drawing

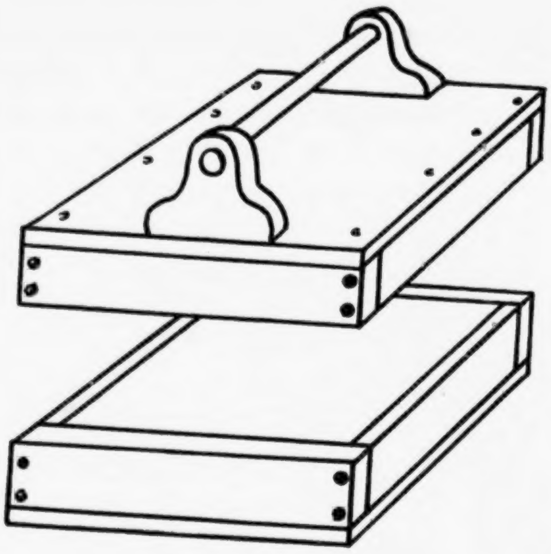

NO 8 FL. HD BRASS WOOD SCREWS
1 1/4" LONG - 8 REQUIRED
1 3/4"
9/16"
3/4"
1/4"
3/4"
4"
16"
8"
4


DRILL & CTSK. FOR NO 8 FL. HD.
WOOD SCREWS
5"
3/4"
1 3/4"
3/16"-R
70°
3"
4"
1/8" x 3/4" x 12" LONG
CRS

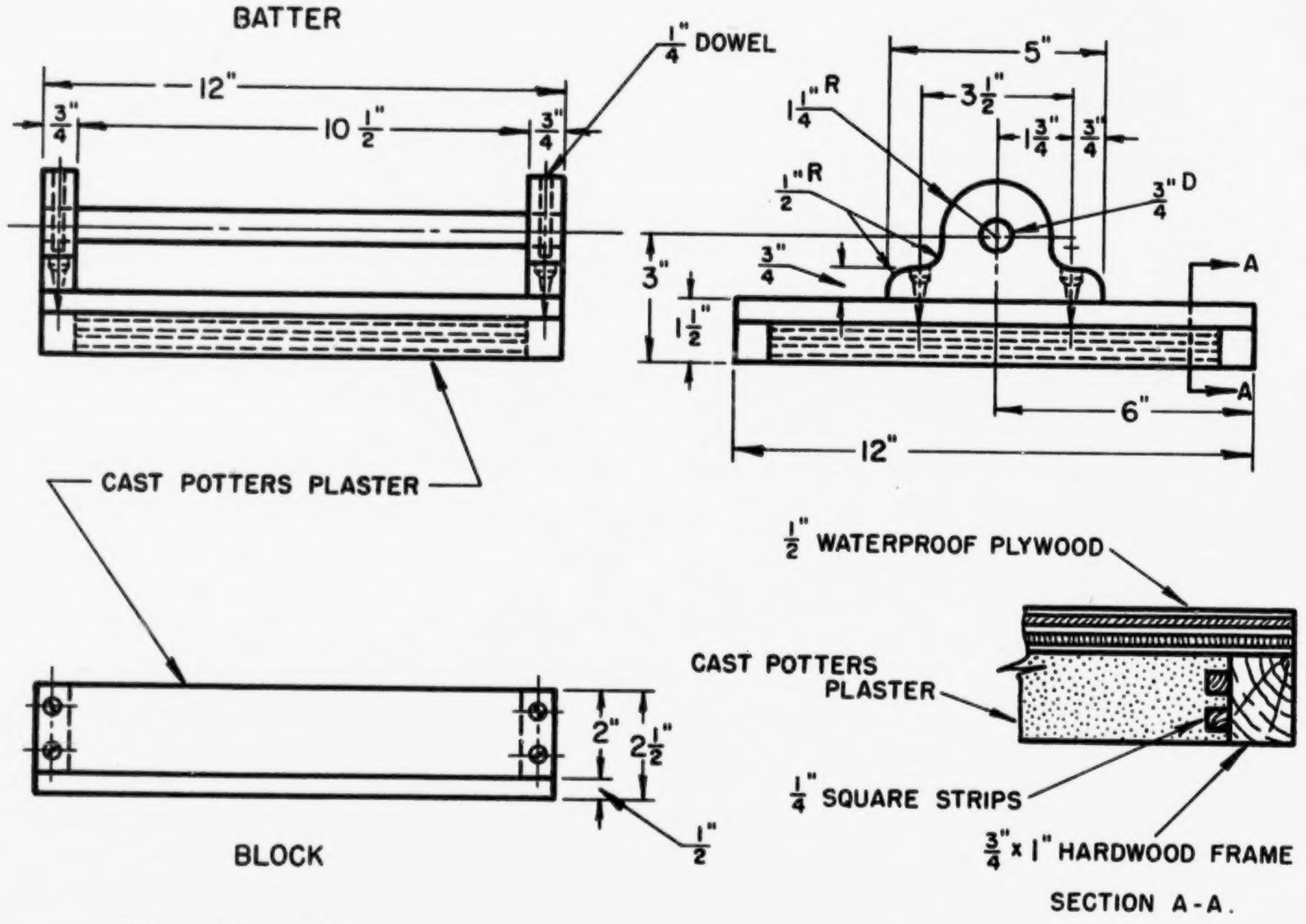
CLAMP DETAIL

BATTING BLOCK AND BATTER

The batting block and batter are used to form a bat of clay in preparation for jiggering. The surface of the clay bat being struck will become the face of the project as it is jiggered bottom up. Some practice and skill are required to produce a good bat.



Working Drawing


BATTER
12"
3/4"
10 1/2"
3/4"
1/4" DOWEL
5"
3 1/2"
1 1/4" R
1 3/4"
3/4"
1/2" R
3/4" D
3/4"
3"
1 1/2"
A
A
6"
12"
CAST POTTERS PLASTER
1/2" WATERPROOF PLYWOOD
CAST POTTERS PLASTER
2"
2 1/2"
1/2"
1/4" SQUARE STRIPS
BLOCK
3/4" x 1" HARDWOOD FRAME
SECTION A-A.

Bill of Material

Block

1 Exterior fir plywood bottom, ½ inch thick x 12 inches wide x 12 inches long
2 Hardwood ends, ¾ inch thick x 2 inches wide x 10½ inches long
2 Hardwood sides, ¾ inch thick x 2 inches wide x 12 inches long
1 Piece unbleached muslin cloth, 14 inches wide x 14 inches long

Batting out a clay bat for jiggering.

Batter

1 Exterior fir plywood base, ½ inch thick x 12 inches wide x 12 inches long
2 Hardwood ends, ¾ inch thick x 1 inch wide x 10½ inches long
2 Hardwood sides, ¾ inch thick x 1 inch wide x 12 inches long
8 Pieces hardwood cleat material, ¼ inch square x 10½ inches long
1 Dowel rod handle, ¾-inch diameter x 12 inches long
2 Dowel rod pins, ¼-inch diameter x 2 inches long
2 Pieces hardwood handle ends, 3 inches x 5 inches
1 Cover, unbleached muslin, 14 inches wide x 14 inches long
1 Mold band (rubber tube)

Procedure

Prepare clay for jiggering process.

Saturate batting block and batter with water.

Cover batting block with a wet cloth to facilitate removing of clay bat.

Attach wet cloth smoothly to the batter with large rubber band.

Place ball of clay in the center of batting block.

Strike clay ball with batter. (Batter must be held parallel to batting block while striking.)

Strike until a clay bat is produced a bit larger in thickness and diameter than the project to be jiggered. (Fewer strokes will tend to produce a better bat.)

Smooth and polish the surface with a large moistened steel spatula. (Avoid stretching the clay in this operation.)

Remove clay bat to the jigger by picking it up on the cloth.

Figure 1 is a device designed to produce bats with surfaces that are parallel even when operated by an unskilled person.

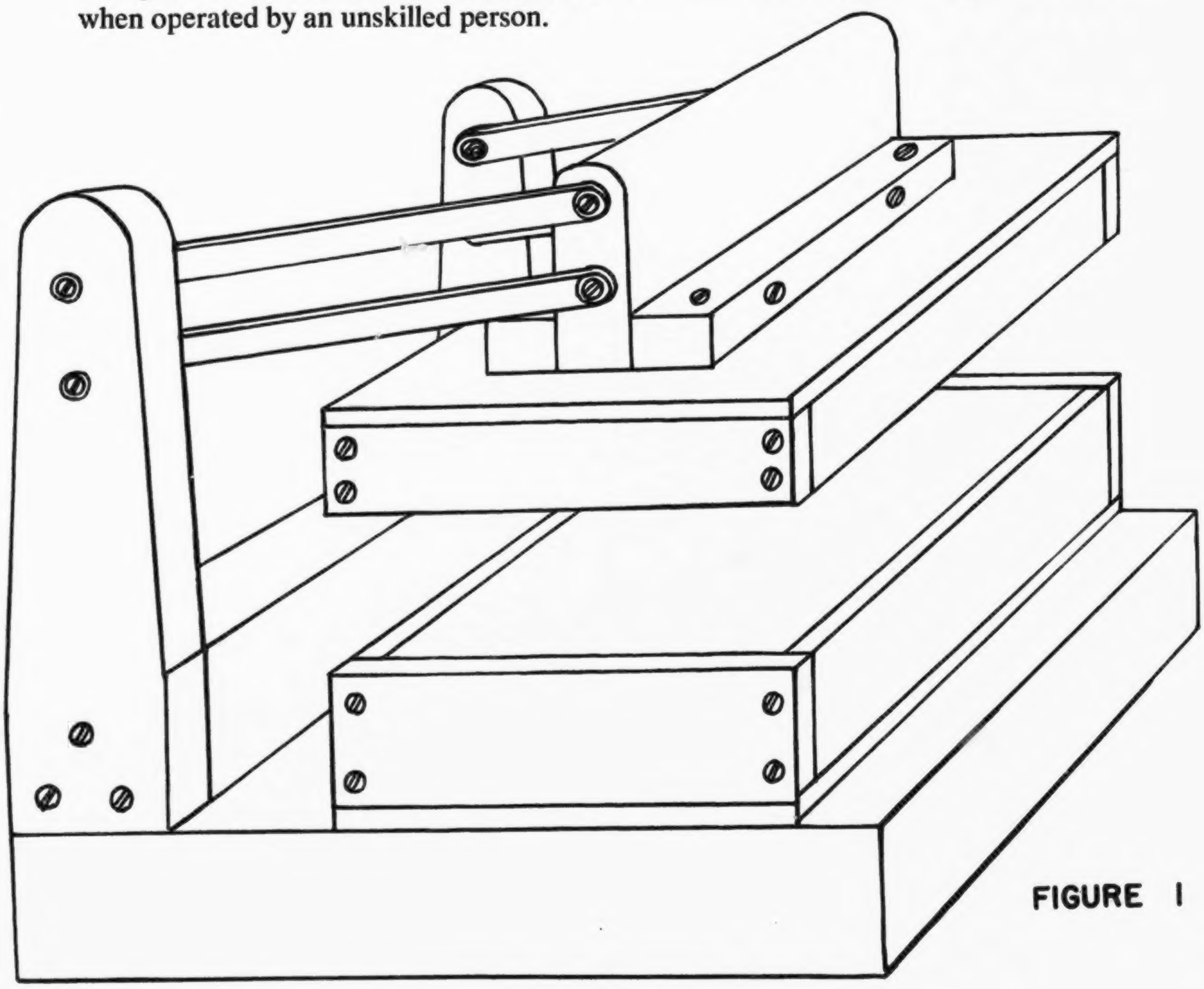
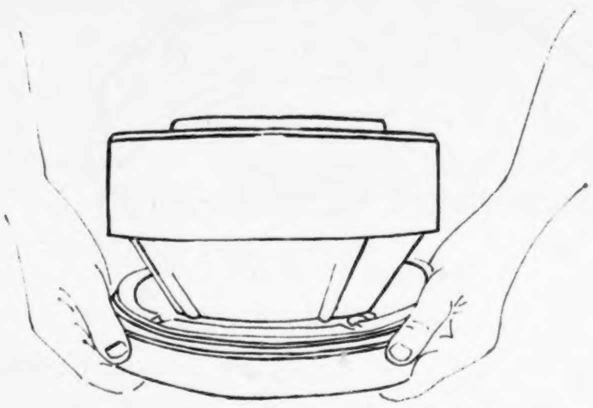


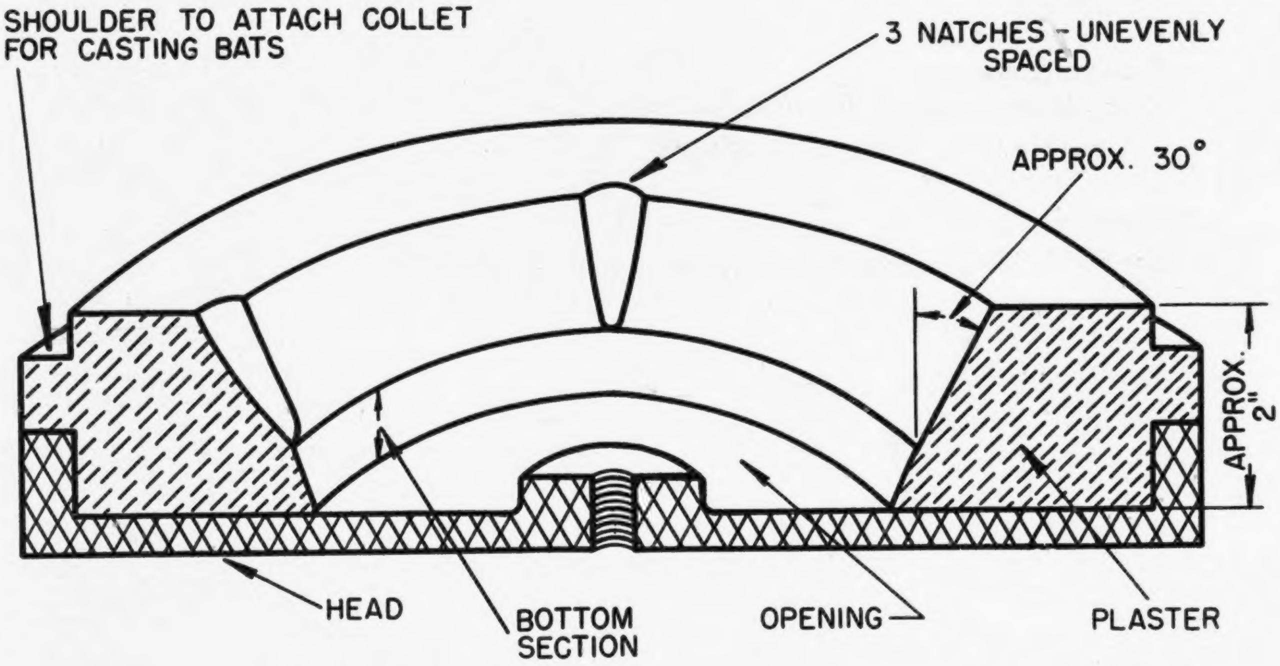
FIGURE 1

POTTER'S WHEEL CHUCK

The chuck is a device, usually made of plaster, which is placed on the potter's wheel head. In it bats used for jiggering, turning, and throwing are held in rigid position. Notches are used to insure alignment and original position when replacing a bat in the chuck. (Make a case mold to produce other chucks giving universal use of all shop-made bats.)

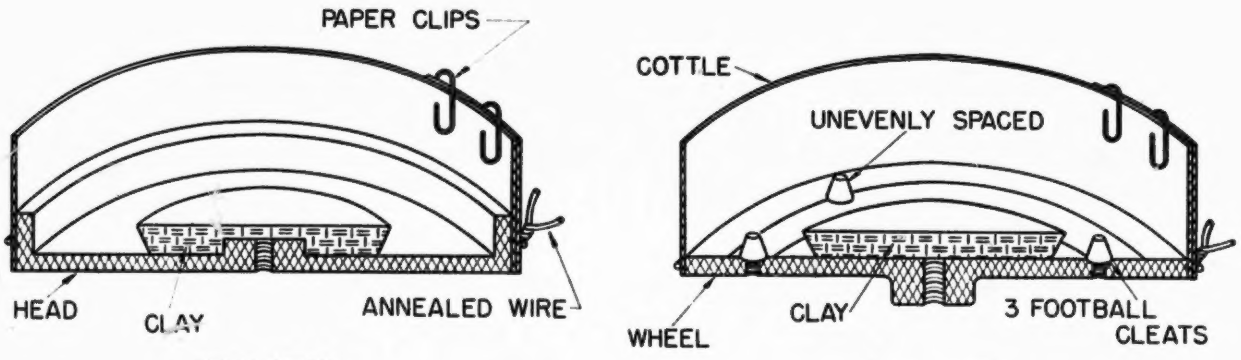


Working Drawing


SHOULDER TO ATTACH COLLET FOR CASTING BATS
3 NATCHES - UNEVENLY SPACED
APPROX. 30°
APPROX. 2"
HEAD
BOTTOM SECTION
OPENING
PLASTER

In order to assist in removing a bat from a chuck make a hole through the chuck's bottom so that one's thumbs can press on the bottom of the bat. (See the Working Drawing.) When making such a chuck first place and shape a clay bat on the center of the wheel. The clay must be as thick as the chuck's bottom section is to be and approximately half its diameter.

Pour the plaster for the chuck then turn its center down to the top surface of the clay bat.


PAPER CLIPS
HEAD
CLAY
ANNEALED WIRE
COTTLE
UNEVENLY SPACED
WHEEL
CLAY
3 FOOTBALL CLEATS

DROP HEAD

FLAT WHEEL

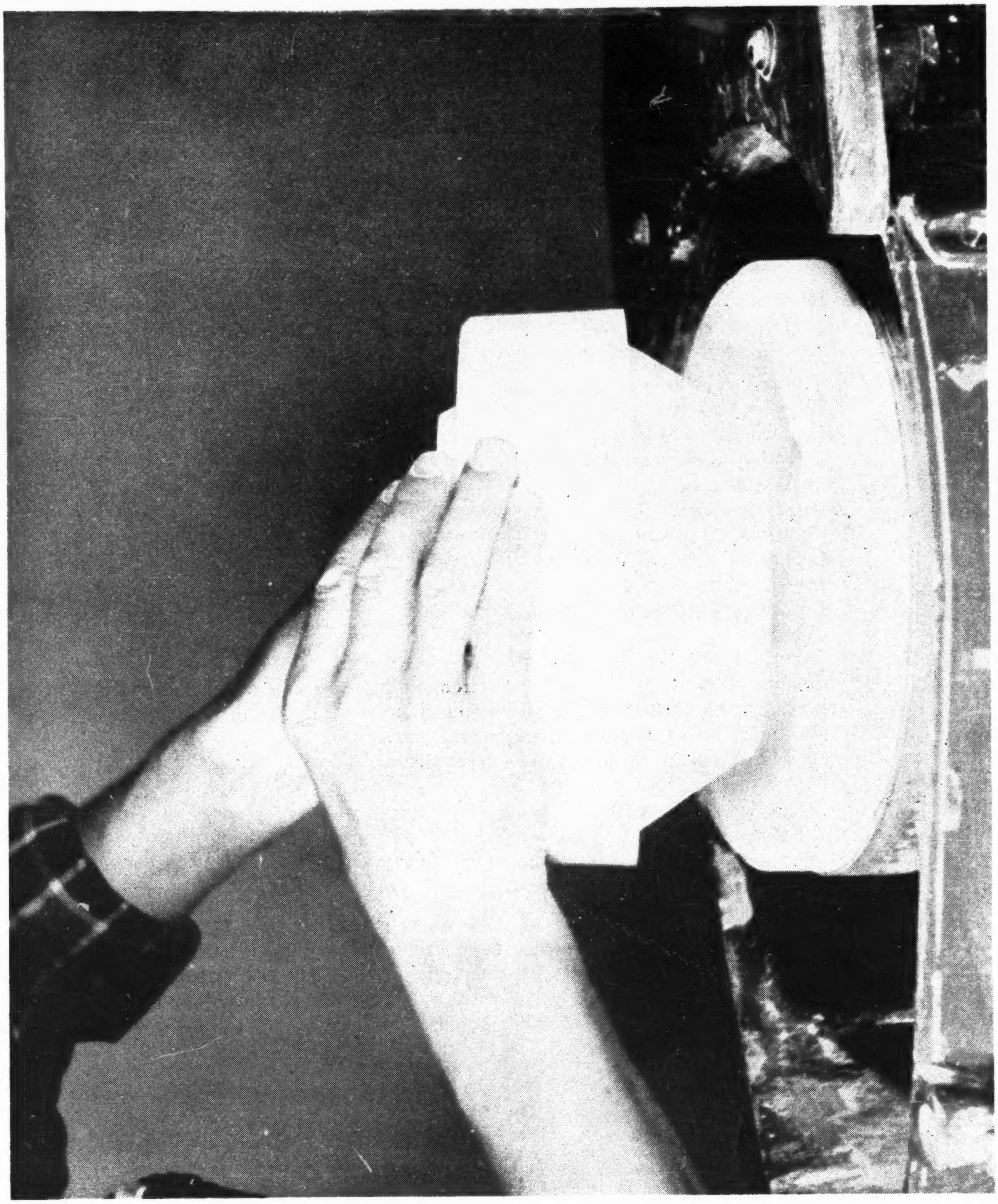
FIGURE 1

Procedure

Place and shape clay bat on wheel or head. (See figure 1.)
Secure cottle to head or wheel with paper clips and wire.
Apply size to wheel and cottle.
Mix plaster.
Pour into cottle.
Remove cottle.
Turn plaster to shape. (See Working Drawing.)
Cut notches. (See Working Drawing.)

Reference

Norton, F. H. *Ceramics for the Artist Potter.* pp. 171-172



Placing a plaster bat in a chuck.

MAKING GLAZES

GLAZE MAKING

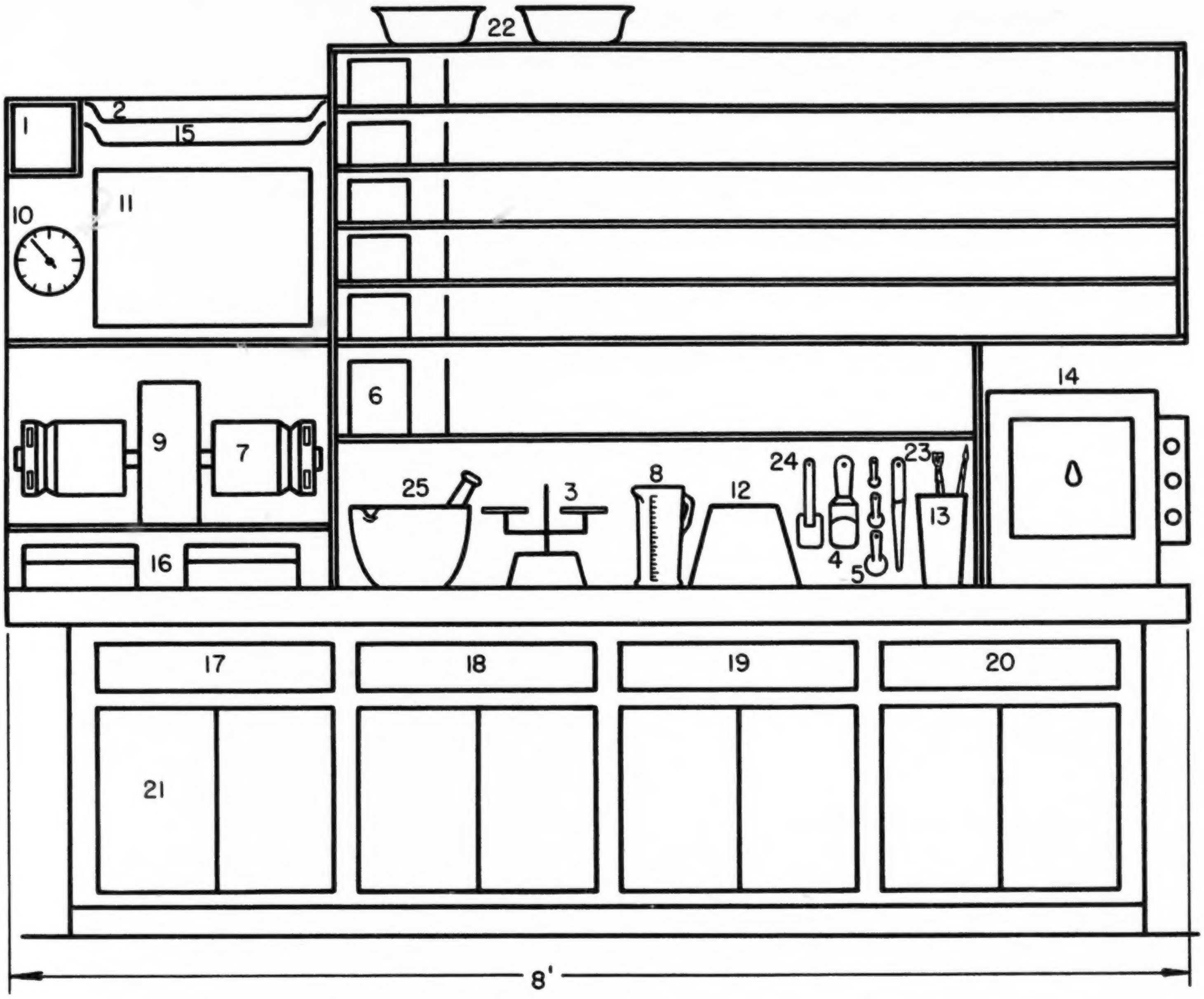
The opening of a kiln after a glaze fire is almost always accompanied by a feeling of suspense. What will one see? Are the glazes matured? Are the colors deep, bright, alive, and glowing? Are the surface textures as intended? The satisfaction of finding beautifully glazed ware in a newly opened kiln is unparalleled when the glazes used were the creation of the potter himself.

The rewarding experience of glaze making can be introduced in an industrial arts ceramic shop for all grades. The simple preparation of glaze slips from powdered commercial glazes is a good beginning project for the seventh grade. The culmination of a well-planned glaze-making program can lead to the calculation, compounding, testing, and use of original glazes by 12th grade students.

Glaze-making projects include such activities as:

Measuring liquids using a graduate.
Grinding materials in a mortar and pestle.
Grinding materials in a ball mill.
Preparing various solutions.
Straining glazes.
Preparing, marking, firing, and recording data on test tiles.
Compounding a basic raw glaze from a recipe.
Compounding a basic frit glaze from a recipe.
Staining a base glaze.
Developing a palette of colors for a base glaze.
Compounding enamel glazes from recipes.
Compounding matt glazes from recipes.
Compounding antique or rutile glazes from recipes.
Making a color line blend from two parent glazes.
Making a tri-axial blend from three parent glazes.
Studying the molecular formula of a basic glaze.
Deriving a simple glaze formula.
Calculating a recipe from a formula.
Calculating a formula from a recipe.
Adjusting glazes to fit bodies or to eliminate glaze defects.
Compounding and testing an original glaze.

Glaze making can be organized so that two or more students work together to produce a glaze. Carefully planned and controlled procedures, using information sheets and a glaze-making bench, as illustrated, can minimize the need for constant and direct supervision. A sample worksheet, designed for use when weighing out a glaze, is illustrated at the end of this unit. The worksheet also serves as a data record sheet for a given glaze project.



GLAZE MAKING BENCH

Key to Glaze-Making Bench Equipment

1. Glaze recipe card file
2. Blank worksheet file
3. Balance
4. Scoop
5. Measuring spoons
6. Glaze ingredients in plastic containers
7. Mill jar with pebbles
8. Graduate
9. Pebble mill
10. Timer alarm clock
11. Chalk data board
12. Funnel sieve (80 mesh)
13. Glaze brushes
14. Test kiln
15. Completed worksheet file
16. Sieves, 50 and 120 mesh
17. (Drawer)—test tiles
18. (Drawer)—china marking pencils
19. (Drawer)—underglaze pencils
20. Pyrometric cones
21. Bulk storage—empty glaze and material containers
22. Basins
23. Fettling knife
24. Rubber bowl scraper
25. Mortar and pestle

Suggested Procedure for Glaze-Making Project

Select glaze to be made—take recipe card from file (1).

Fill out blank worksheet obtained from file (2).

Assemble balances (3), scoop (4), measuring spoons (5), glaze ingredients (6), and mill jar with clean pebbles (7).

Weigh out each dry ingredient separately—pour into mill jar and check off on worksheet.

Measure liquid glaze media in graduate (8) and add to mill jar.

Label mill jar with marking pencil (18) and set jar into mill (9).

Set timer clock (10). Mark data on board (11). Start ball mill.

Set funnel sieve (12) into empty plastic container (21).

Drain contents of mill jar into funnel sieve.

Cover and label glaze container.

Wash pebbles clean while in funnel.

Wash mill jar, replace clean pebbles.

Obtain test tile (17) and apply glaze for test fire.

Use underglaze pencil (19) and mark data on back of tile.

Fire test tile in test kiln (14).

Record results on worksheet and place in record file (15).

GLAZE PROJECT WORK SHEET

Date ____________________

Type and Color of Glaze: ____________________ **(Student's Name)** ____________________ **(Class)** __________

Glaze Test # __________ **Cone #** __________

List of Ingredients	**Quantity to be Weighed**

Grinding Data:

Date ____________________

Mixing Media ____________________

Grinding Time ____________________

Total Weight ____________________

Quantity ____________________

Jar Number ____________________

Fire Test Data:

Clay Body ____________________

Bisque Fired to Cone # __________

Data Recorded on Test Piece

Glaze Test # ____________________

Glaze Fire Cone # ____________________

Results of Glaze Fire:

FRIT GLAZES

A glaze-making program based upon the use of lead or leadless frits requires a minimum investment in material and a limited knowledge of the field of glaze chemistry.

Familiarity with the Seger ceramic formula will permit an individual to introduce frits into almost any published formula. Lack of familiarity with the formula, however, need not deter an experimental frit glaze formula.

Frits are readily adaptable to low fire glazes in the cone 08-03 temperature range. Reference to supplier catalogs will provide information pertinent to the selection of frits. In most cases frit formulas are available from manufacturers upon request.

A material list, with suggested quantities for a 1-year program follows:

GLAZE CONSTITUENTS	*Quantity*	COLORANTS	*Quantity*
Alkaline frit	20 lbs.	Copper oxide	½ lb.
Lead frit	20 lbs.	Cobalt oxide	¼ lb.
Whiting	2 lbs.	Iron oxide	1 lb.
Feldspar	3 lbs.	Manganese carbonate	¼ lb.
China clay	3 lbs.	Nickel oxide	¼ lb.
Flint	2 lbs.	Chromium oxide	½ lb.
Tin oxide	1 lb.	Titanium oxide (Rutile)	½ lb.
Zinc oxide	1 lb.	Yellow base	½ lb.
Barium carbonate	1 lb.	Pink base	½ lb.
		Orange base	½ lb.

In place of color oxides commercial glaze stains or underglaze pigments can be obtained and used in quantities recommended by the manufacturers.

Drawing from the listed materials, a simple frit glaze can be made up as follows:

Frit 90 parts
Clay 10 parts

Test samples fired to various temperatures will reveal characteristics of the above recipe. Adjustment can be made as follows:

A. To alter the maturing (melting) temperature:
  Upward—add varying amounts of silica (flint),
  Downward—add varying amounts of flux—whiting—feldspar.

B. To prevent or modify running of glaze: add clay.

C. To prevent crazing (shrinkage cracks in cooled glaze coat): add flint.

Note: Any of the above additions are to be made at the expense of the amount of frit; i.e., if 5 parts of clay are added, 5 parts of frit must be removed.

D. To color the base glaze the following table can be used:
(All colorants are added to the base formula above.)

Color	*Material*	*Amount*
Green	Black copper oxide	2 to 5% (in lead base frit)
Turquoise	Black copper oxide	2 to 5% (in alkaline frit)
Opaque green	Chromium oxide	1 to 3%
Yellow	Yellow stain	1 to 10%
Blue	Cobalt oxide	¼ to 1%
Brown	Red iron oxide	5 to 10%
Grey to brown	Nickel oxide	½ to 3%
Purple	Manganese carbonate	2 to 6% (in lead base frit)
Plum	Manganese carbonate	2 to 6% (in alkaline base frit)
Pink	Pink stain	5 to 10%

Color can be mottled or made to streak by adding up to 8% rutile.

E. To make the base glaze opaque tin oxide can be added in varying quantities up to 10 percent.

F. To change the base to a mat glaze the proportions of the base glaze must be altered to raise the percentage of clay. This change may also necessitate raising the amount of flux to keep the desired maturing temperatures.

APPENDIXES

GLOSSARY OF CERAMIC TERMS

Absorption. Taking up of water in the pores of a material.

Alumina. Aluminum oxide, present in clay and glazes.

Ball clay. An extremely fine-grained, plastic, sedimentary clay. Although ball clay contains considerable organic matter, it fires out white or near white in color. It is usually added to porcelain and whiteware bodies to increase plasticity.

Ball mill. A rotating jar containing pebbles and charge, used for mixing or fine grinding.

Bas-relief. Low modeling on a flat or curved surface.

Bat. A plaster slab or disk on which clay is worked, or on which objects are formed and dried. Sometimes, a fire-clay slab for setting in the kiln.

Batch. A mixture of weighed ingredients.

Bentonite. Special clay of volcanic origin used in small amounts to increase workability of bodies, or to suspend glazes.

Biscuit. Unglazed fired ware.

Bisque. See Biscuit.

Blank. An undecorated piece.

Block mold. The original mold for a pottery form, made directly from the model and used only for making working molds.

Blunge. To mix thoroughly, as slip.

Body. A mixture of clays and nonplastics that is workable and has suitable firing properties.

Body stain. Stains used in clays to change the color of the bisque.

Bone china. Soft porcelain of high translucency having 0.3 to 2 percent absorption, made with bone ash as a flux. Produced mainly in England.

Burnishing. Polishing with a stone or steel tool on leather-hard clay.

Case mold. A plaster pattern cast in a block mold and used to make a number of duplicate plaster molds for producing identical pieces of ware.

Casting. Process of forming objects in plaster molds from a slip.

Ceramics. Art and science of forming objects from earthy materials with the aid of heat or fire.

China. Whiteware, vitreous and more or less translucent, biscuit-fired at a moderate temperature and glost-fired at a lower temperature. Its absorption is less than two percent.

China clay. Residual kaolin mined in Southern England and various parts of United States.

Chuck. A form, mounted in a lathe or potter's wheel in which ware is set for turning.

Chum. A form, mounted in a lathe, on which hollow ware is set for turning.

Coiled ware. A hand method of forming pottery by building up the walls with rope-like rolls of clay and then smoothing over the joints.

Combing. A method of decoration developed by dragging a coarse comb or tool over two contrasting layers of wet clay slip or glaze.

Cottle. A rectangular or circular wall made from such material as wood, sheet metal, clay, or plastic to retain cast plaster when poured.

Damp cabinet. Metal lined cabinet in which unfinished clay objects are stored to prevent their drying out.

Decalcomania (decal). A transfer pattern for decorating ware.

Deflocculate. To disperse a clay suspension so that it has little tendency to settle and has a low viscosity, together with a low water content.

Dipping. Glazing by immersing the biscuit piece in a glaze slip.

Draw. To take ware from the kiln.

Dry-foot. Ware with no glaze on the foot.

Earthenware. Low-fired pottery (under 2,000° F.), usually red or tan in color with an absorbancy of from 5 to 20 percent.

Embossing. A process of applying a design to the surface of plastic clay by depressing the background of the design by stamping, rolling, or striking.

Enamel. An opaque, glossy glaze. Also glass-like coating on metal products.

Engobe. White or colored slip applied to a fired or unfired body. It may or may not be covered with a glaze.

Extrusion. The process of making shapes, such as drain tile, by forcing plastic clay through dies.

Fettle. To remove fins, mold marks, and rough edges from dry, or nearly dry, ware.

Filter press. A machine for removing some of the water from a slip to make clay plastic.

Fire. To heat in a kiln to the required temperature.

Fit. Adjustment of a glaze or slip to a body.

Flatware. Plates, saucers, platters, round and oval dishes, and trays.

Flint (potter's flint). In Europe, a crypto-crystalline variety of quartz ground from flint pebbles. In this country, finely ground quartz sand.

Flocculate. To thicken a clay suspension by the addition of an acid.

Flow glaze. Glaze with enough fluidity in the kiln to flow down the ware, usually having intermingling colors.

Flux. A fusing agent which facilitates the melting of a glaze and the maturing of clay.

Foot. The base of a pot on which it rests, usually a ring.

Frit. Special water-insoluble glass for use in a body or glaze.

Glaze. A liquid suspension of finely ground minerals which is applied by brushing, pouring, spraying, etc., on the surface of bisque-fired ceramic ware. After drying, the ware is fired to the temperature at which the glaze ingredients will melt together to form a glass surface coating.

Glaze firing. A firing cycle to the temperature at which the glaze materials will melt to form a glass-like surface coating when cooled.

Greenware. Formed pottery which has been air dried but not fired.

Grog. Crushed hard-fired clay, used in terra-cotta and refractory bodies to reduce shrinkage and warpage.

Grout. A substance used to fill the joints between tile.

Gum. Various materials such as gum arabic, gum tragacanth, corn syrup, and methyl cellulose used to promote adhesion and improve brushing qualities of glazes and underglazes.

Hard porcelain. True porcelain composed of china clay, feldspar, and flint. Body and glaze are fused and fired together at cone 12 or more.

Hump. An inverted form made from various materials over which clay or plaster may be formed.

Jigger. A process of forming clay products. A mold shaping one side revolves against a template which shapes the other side. Also, the machine on which this forming is done.

Joggles. Notches and matching projections on facing surfaces of plaster molds to provide alignment.

Jolley. The terms jigger and jolley become confusing through usage. By and large, in this country, jigger and jiggering are applied to the production of both flat and hollow ware by mechanical means when one side of the ware is formed in (or over) a plaster bat and the other by a template swinging on an arm. When the template is introduced into hollow ware by sliding on verticle rods, this operation is still referred to as jolleying.

Kaolin. $(Al_2O_3 \bullet 2SiO_2 \bullet 2H_2O)$ Pure clay, also known as China clay. Used in glaze and porcelain bodies. Fires out to pure white.

Kiln. A refractory-lined chamber, with means for heating it, in which ceramic ware is fired.

Kiln furniture. Refractory slabs, posts, and setters for supporting ware in the kiln.

Leather hard. The condition of clay which has stiffened sufficiently to be handled without deformation but which is still moist enough to be worked on with turning and modeling tools.

Luster. Surface iridescence caused by a very thin layer of metal on top of the glaze.

Majolica glaze. Opaque glaze with a glossy surface. Tin oxide is often used.

Marbled ware. Ware made from several colored bodies partially mixed together to give a veined effect like marble.

Matt glaze. Glaze with a dull or eggshell finish.

Maturing. Reaching the proper temperature to develop the desired properties.

Model. Original form in clay, plasticine, plaster, or wood.

Molds (also mounds). A form or box, usually of plaster of paris containing a hollow negative shape. The positive form is made by pouring either wet plaster or slip into this hollow.

Mortar and pestle. A glass or porcelain bowl (mortar) in which glaze ingredients are mixed by the action of the pestle, rolled and rotated by hand.

Notch. A key used to register two halves of a plaster mold. It may be of plaster or a brass insert (sometimes called joggle).

Open. To make a depression in the centered ball of clay. The clay is depressed toward the wheel head and the thickness of the bottom is gauged.

Overglaze. Ceramic colors applied over a fired glaze and then refired to relatively low temperatures.

Plaster of paris. Hydrated calcium sulfate ($CaSO_4 \bullet 2H_2O$) which sets after mixing with water to form a firm block. Used by the potter for molds, models, and patterns.

Plasticity. Property of yielding under pressure without cracking and then retaining the new shape after the pressure is released.

Porcelain (hard porcelain, European porcelain). Mechanically strong, highly translucent body with no absorption. The biscuit is low fired, but the glaze is fired to a very high temperature and is hard and resistant to abrasion.

Potter's wheel. The revolving wheel on which clay is shaped. The wheel is either foot-powered or motor-driven.

Pressing. Forming plastic clay in a plaster mold by forcing it against the mold face.

Pug mill. A machine which kneads clay to make it more plastic and dense; usually combined with a de-airing machine which removed air from the clay, for maximum density.

Pyrometer. Instrument for measuring high temperatures.

Pyrometric cones. A series of small pyramids of earthy materials, each of which softens with a specified heat treatment (combination of temperature and time). They are much used as indicators in firing.

Raku. Very soft, porous earthenware with a lead borate glaze, made in Japan chiefly for the Tea Ceremony.

Raw glaze. Glaze containing no frit.

Reducing agent. Material in a body or glaze that gives off carbon monoxide on firing.

Refractory. Quality of resisting the effects of high temperatures. Also the term given to materials high in alumina and silica used for making kiln insulation, muffles, and kiln furniture.

Resist. A masking agent such as wax or varnish covering portions of the body or glaze to prevent the adhesion of any material placed over it.

Rib. A tool used in throwing a pot.

Screen. A container having a bottom of woven bronze wires for sizing particles.

Set. To place ware in a kiln; or to harden, as with gypsum plaster.

Sgraffito decoration. Decoration in which an engobe is incised to let the body color show through.

Short. Showing only slight plasticity, as a body or clay.

Shrinkage. Contraction of clays or bodies in drying or firing.

Size. A substance such as soap coating, which prevents fresh plaster from sticking to old.

Slake. The process of combining with water. When plaster of paris or clay is sifted into water, it is allowed to soak before mixing.

Slip. A suspension of ceramic materials in water.

Slip decoration. A decorating technique in which colored slips are painted or trailed onto ware.

Spare. Generally an additional portion of plaster shaped at the top of a model which causes a hole to be formed in its mold through which slip is poured. This also provides extra clay at the top of the freshly cast piece which is available for trimming and finishing.

Sprigging. Clay applied in a plastic state to form a decoration in relief.

Stain. An oxide used as a stable coloring agent not altered by action of glaze or heat and used to color over underglazes and clay bodies.

Stoneware. A high-fired body with 0 to 5 percent absorption but no translucency. The color is grey, red, or buff and the piece may have a normal or a salt glaze.

Template. A profile gauge used to check or form the shape of pottery.

Terra cotta. Unglazed body, generally of red color, used for sculpture, often containing grog.

Throwing. The operation of forming pieces on the potter's wheel from a plastic body.

Transfer printing. Printing under or over the glaze decorations from an engraved plate or screen by the intermediate step of a special transfer paper.

Turning. Trimming a piece in leather-hard condition on a lathe or potter's wheel.

Underglaze. Color decoration on the body, later covered with a transparent glaze.

Vitreous. A body or glaze which is hard, glassy, and nonabsorbent.

Warping. Twisting out of shape in drying or firing.

Wedging. Working a plastic body to make it homogeneous and to eliminate the air.

Welding. The process of joining two pieces of clay so that they become one.

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